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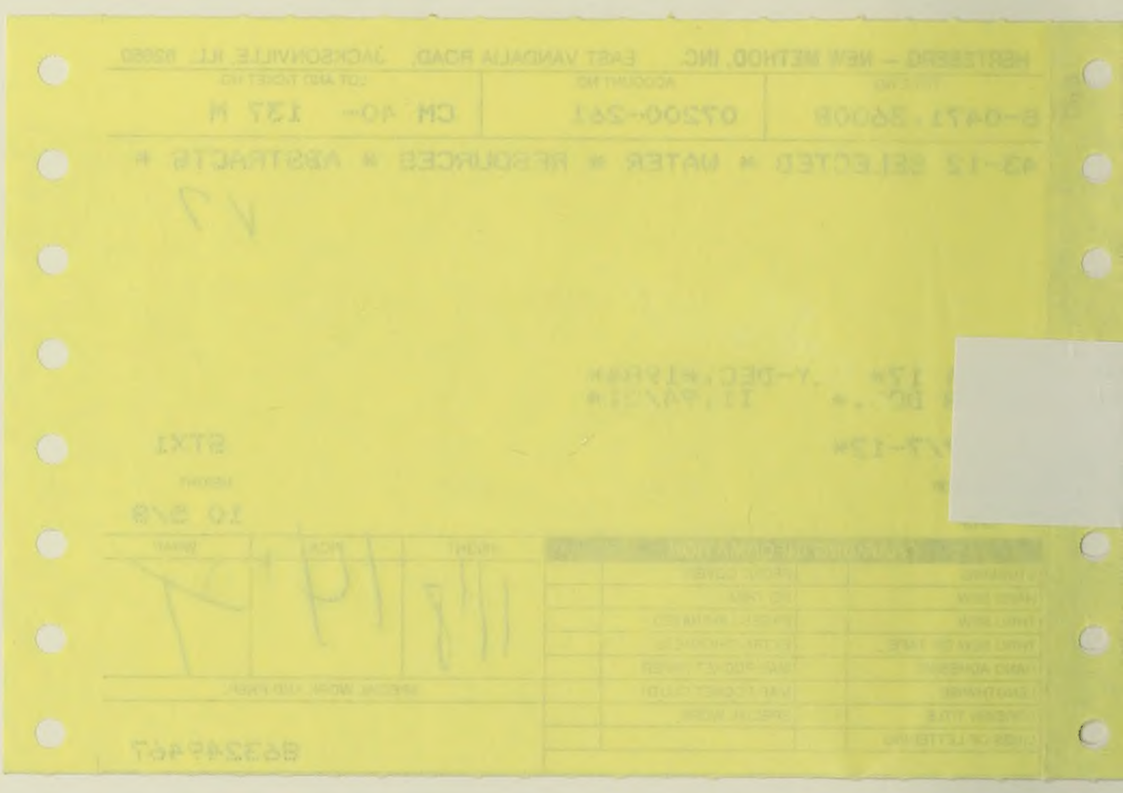

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 7
JULY 1984

W84-02125 -- W84-02479

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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SUBJECT INDEX

AUTHOR INDEX

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TIME-VARIANT NONLINEAR FUNCTIONAL RUNOFF MODEL FOR REAL-TIME FORECASTING,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
G. G. Patry, and M. A. Marino.
Journal of Hydrology, Vol. 66, No. 1-4, p 227-244, October, 1983. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Forecasting, Rainfall, Mathematical studies.

A time-variant nonlinear functional runoff model based on a Volterra-Wiener series representation is presented for real-time runoff forecasting purposes. Using parameter vectors based on actual rainfall-runoff responses, it is shown that the recursive least-squares (RLS) and recursive extended least-squares (RELS) algorithms can provide accurate and consistent parameter estimates under a variety of noise conditions. Rainfall-runoff relationships characterized by a low signal to noise ratio result in less stable and less accurate parameter estimates. Finally, from a practical point of view, the proposed model offers the possibility of tracking in real-time slow variations in rainfall-runoff response brought about by changes in moisture conditions, evapotranspiration rates or any other factor that would tend to slowly modify the rainfall-runoff response of a catchment. (Baker-IVI)
W84-02468

2B. Precipitation

METEOROLOGICAL ASPECTS OF THE EL NINO/SOUTHERN OSCILLATION,
National Weather Service, Washington, DC. Climate Analysis Center.
E. M. Rasmusson, and J. M. Wallace.
Science, Vol. 222, No. 4629 p 1195-1202, 16 December, 1983. 6 Fig, 34 Ref.

Descriptors: *Climate, *El Nino, *Ocean surface temperatures, Rainfall, Drought, Snow, Storms, Weather, Monsoons, Seasonal variation.

The single most prominent signal in year-to-year climate variability is the Southern Oscillation, which is associated with fluctuations in atmospheric pressure at sea level in the tropics, monsoon rainfall, and wintertime circulation over North America and other parts of the extratropics. The past 18 months have been characterized by what is probably the most pronounced and certainly the best-documented El Nino/Southern Oscillation episode of the past century. It resulted in severe droughts in Indonesia, eastern Australia, Melanesia, southern India, Sri Lanka, and southern Africa, and extreme rainfall in Ecuador, northern Peru, and the central Pacific. In the United States, there were an unusual number of winter storms that brought flooding to parts of California and the Gulf states, and buried mountain regions of the Southwest with heavy snow in late winter and spring. In this review meteorological aspects of the time history of the 1982-1983 episode are described and compared with a composite based on six previous events between 1950 and 1975. The peculiar time history of the 1982-1983 episode invites speculation as to whether all such episodes might be viewed as a superposition of two, interrelated kinds of events, which usually occur in combination about 6 mo apart: an enhancement of the mean annual cycle in SST (sea-surface temperature), largely confined to the eastern third of the Pacific; and a broader scale warming of the equatorial Pacific from near the dateline eastward. The 1982-1983 episode can be interpreted as the same events in the reverse sequence. (Moore-IVI)
W84-02139

BASIC STRUCTURE OF DAILY PRECIPITATION SERIES,
George Washington Univ., Washington, DC. School of Engineering and Applied Science.
V. Yevjevich, and T. G. J. Dyer.
Journal of Hydrology, Vol. 64, No. 1/4, p 49-67, July, 1983. 11 Fig, 7 Ref. NSF grant CME-7916817.

Descriptors: *Precipitation, *Stochastic process, Mathematical studies, Probabilistic process, Model studies, Fort Collins, Durango, Colorado, Austin, Texas.

To analyze the structural properties of daily precipitation series, records of three precipitation stations were used: Fort Collins, Colorado, with a total length of series of 69 yr.; Durango, Colorado with a total length of series of 71 yr; and Austin, Texas with 70 yr. Their respective average annual precipitation values are 14.32, 19.02, and 33.02 in, respectively. The major objective of this study was to present an in-depth understanding of series structure. Difficulties in estimation of series parameters and in derivations of inferences from fluctuations within the year of these parameters are particularly emphasized. All parameters of daily precipitation series proved to be periodic within the year (probability of zero precipitation, run-lengths of zero and non-zero values) regardless of whether the sampling variation in the estimated parameters permits or not the inferences on periodicity either by visual inspection or by the statistical inferential techniques available. Periodicity curves were estimated by averaging 365 daily values over intervals of 14, 28, or 61 days. Coefficients of variation, skewness and kurtosis, because of their definitions, show less periodicity than other parameters. It is likely that the accuracy of modeling of daily precipitation series, and of the series that are highly related to them such as runoff, evaporation, infiltration or water quality series, will not be improved until the basic structure of precipitation time series in general, and of their periodicity, intermittency and stochasticity, as well as their interrelationships in particular, are investigated in depth. (Baker-IVI)
W84-02201

RAINFALL INTERSTATION CORRELATION FUNCTIONS; VII. ON NON-MONOTONOUSNESS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
Ph. Th. Stol.
Journal of Hydrology, Vol. 64, No. 1/4, p 69-92, July, 1983. 9 Fig, 8 Tab, 55 Ref.

Descriptors: *Spatial distribution, *Rainfall distribution, Storms, Mathematical studies, Forests, Soil moisture, Interstation correlation.

Empirically derived rainfall interstation correlation functions may show the property of non-monotonousness. Besides the maximum correlation at interstation distance D = O, the occurrence of secondary maxima has been reported in the literature. It is thus assumed that this phenomenon is caused by arrays of storm cells or by competing of mesoscale systems that pass the area under investigation. In analytical solutions of rainfall interstation correlation functions, tri-rectangularly shaped storm models have been used to produce a continuous range of different storm models. This range involves peaked, flat and cellular structured storm profiles. The theoretical interstation correlation functions for such a range of models changes in a natural way from never increasing to non-monotonically structured functions. Inter-cell distances then appear as a parameter in the correlation functions. (Baker-IVI)
W84-02202

OXYGEN-ISOTOPIC COMPOSITION OF ARCTIC PRECIPITATION,
R. A. Vaikmaje, and J.-M. K. Punning.
Water Resources, Vol. 9, No. 5, p 490-496, September-October, 1982. 4 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No. 5, p 52-58, September-October, 1982.

Descriptors: *Precipitation, *Arctic regions, *Oxygen isotopes, Chemistry of precipitation, Evaporation, Atmosphere, Glaciers, Paleoclimatology.

The isotopic composition of precipitation is determined by equilibrium in the system ocean-atmosphere-ocean (or land water bodies). Evaporation and formation of the original isotopic composition of atmospheric moisture, variation of the isotopic composition of the phase left in the atmosphere during migration of air masses, and finally, the formation of the final isotopic composition of precipitation during condensation occur in this cycle. The establishment and analysis of regularities of these processes are of paramount importance when studying atmospheric circulation. The establishment of relations between the isotopic composition of precipitation and climate-forming factors of the environment permits reconstructing the paleoclimatic and paleogeographic conditions on the basis of determining the oxygen isotopic composition variations in vertical glacier profiles. The analysis as performed permits assuming localization of the main source of precipitation in the Atlantic sector of the Arctic Ocean at 60 degrees, within the Icelandic-Kara low. A large contribution of the local water area to the formation of atmospheric moisture is observed everywhere. (Baker-IVI)
W84-02327

DROUGHT-INDUCED CHANGES IN CRAYFISH POPULATIONS ALONG A STREAM CONTINUUM,
Georgia Univ., Athens. Dept. of Zoology.
R. C. Taylor.
American Midland Naturalist, Vol. 110, No. 2, p 286-298, October, 1983. 5 Fig, 2 Tab, 39 Ref.

Descriptors: *Crayfish, *Drought, *Population dynamics, Streams, Georgia, Sandy Creek, Piedmont Plateau, Drainage basins, Aquatic habitats, Reproduction.

Significant variations were noted in crayfish populations in 2nd- and 5th-order streams in NE Georgia between sites within 1 year and between years. The 1st year experienced normal rainfall and the second, a severe drought. Of two crayfish species that inhabit the drainage the burrowing species (Cambarus latimanus) showed no significant changes, whereas the nonburrower (Procambarus spiculifer) exhibited large drought-induced population changes, including reductions in adult population densities, resident densities and body size, an alteration in the reproductive timing and an increase in the number of juveniles in the population. Many of the changes in P. spiculifer may have resulted from their size-dependent preference for deep water sites, and the reduction of these sites during the drought led to adult emigration and increased predation on larger adults. The distribution of population variables between study sites exhibited the same depth-dependent distribution, the shallower reaches having small populations of small adults and large numbers of juveniles. As the habitat depth decreased during the drought, the above subpopulation properties adjusted spatially, apparently following the physical conditions to which they were adapted. These results agree with the stream continuum concept. (Baker-IVI)
W84-02374

HEAVY RAIN IN THE MIDDLE EAST RELATED TO UNUSUAL JET STREAM PROPERTIES,
Hebrew Univ., Jerusalem (Israel). Dept. of Atmospheric Sciences.
U. Dayan, and R. Abramski.
Bulletin of the American Meteorological Society, Vol. 64, No. 10, October, 1983. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Storms, *Wind, *Middle East, *Flooding, *Rainfall, Saudi Arabia, Jet stream, Climatology, Arid zones, Israel, Sinai Peninsula, Egypt.

A major and fatal flooding event illustrative of rare similar cases in the Middle East was studied. This event, occurring in February of 1975, was compared with three other instances of heavy rains in the same region of the Middle East, two cases in the winter of 1976 that affected parts of Saudi Arabia and south Jordan, and one case in upper Egypt in the winter of 1977 causing heavy rains in the vicinity of Lake Nasser. In all cases the jet stream axis was anticyclonic and in a reversed position. At no other times during this observed period was the jet stream reported to be reversed.

This irregular reversed structure and anticyclonic curvature was associated with a deep and very moist warm air mass above the region. (Baker-IVI)
W84-02390

RAINFALL INTERCEPTION BY AN EVERGREEN BEECH FOREST, NELSON, NEW ZEALAND,
Forest Research Inst., Christ Church (New Zealand).
L. K. Rowe.
Journal of Hydrology, Vol. 66, No. 1-4, p 143-158, October, 1983. 5 Fig, 6 Tab, 38 Ref.

Descriptors: *Interception loss, *Rainfall, *Forest hydrology, Nelson, New Zealand, Interception, Donald Creek, Creeks, Canopy, Throughfall, Seasonal variation.

Data collected over a five year period from April 1977 to March 1982 on a site with a mixed beech canopy was analyzed. The final year of data was used to test the rainfall-interception loss relationships derived from the earlier data. Throughfall under the forest canopy at Donald Creek, Nelson, averaged 69% of the rain falling on the canopy, for 1060 mm of 1530 mm a year. Interception loss averaged 29% of the annual rainfall, or 440 mm/year, using an estimate for stemflow at 2% of the gross rainfall. Seasonal differences in interception loss were significant, ranging from 22% in winter to 35% in summer, and resulted from seasonal variation in evaporation rates from a wet canopy. Seasonal variation in rainfall rate was slight. Comparisons of predicted and observed interception were made to test four models: storm linear regression, monthly linear regression, sine curve and Gash's analytical model. All gave very satisfactory estimates of less than 10% error, and tended to slightly underestimate the measured interception loss. (Baker-IVI)
W84-02463

MAXIMAL RAINFALL ON A SURFACE - THE EPICENTRE COEFFICIENT OF 1- TO 48-HOUR RAINFALL,
CEMAGREF, Antony Cedex (France). Dept. Ressources en Eau.
G. Galea, C. Michel, and G. Oberlin.
Journal of Hydrology, Vol. 66, No. 1-4, p 159-167, October, 1983. 5 Fig, 8 Ref.

Descriptors: *Rainfall, *Estimating, Rainfall area, Rainfall distribution, Spatial distribution, Paris, France.

A sampling tool allowing the hydrologist to determine maximal point rainfall in a given space has been presented using the epicenter coefficient. Its validity should be tested before it can be applied to climates different from that of the Paris (France) area. Once the maximal point rainfall on a surface of area S has been defined, the estimation of its quantiles is carried out in relation to a local rainfall quantile of the same frequency. This ratio, called the 'epicenter coefficient', is then put into an analytical form as a function of the following four variables: area of the studied region, rainfall duration, return period and number of points (or subregions) among which the maximum rainfall was chosen. (Baker-IVI)
W84-02464

USE OF CORRELATION LINKAGES IN THE ASSESSMENT OF DAILY RAINFALL PATTERNS,
Saint David's Univ. College, Lampeter (England). Dept. of Geography.
G. N. Sumner.
Journal of Hydrology, Vol. 66, No. 1-4, p 169-182, October, 1983. 3 Fig, 11 Ref.

Descriptors: *Rainfall distribution, *Forecasting, Mapping, Model studies, Topography, Hydrologic systems, Continental Divide, Australia, New South Wales.

A cartographic technique to indicate discrete rain areas and provide a visual estimate of the degree of correlation distance - decay functions over a wide area is illustrated using a large body of daily rainfall data for a part of Australia. The technique provides a ready and speedy means by which general rainfall patterns may be indicated for a wide area. It does not permit statistical significance levels to be assigned to the relationships obtained. It does provide a convenient, visual and information indication of general rainfall associations; permits a ready visual comparison of month to month charges permitting an overview of seasonal trends; permits the delimitation of approximate rainfall areas based on the presence or absence, frequency and magnitude, of correlation linkages; and it provides a crude assessment of the nature of general correlation fields, indicating anisotropic trends. For New South Wales the technique indicated that the time between April and October the Divide emerges as an important barrier to rainfall occurrence; correlation distance-decay rates are small measured parallel to the Divide and on its coastal flank in particular. In the warmer part of the year rainfall patterns are less constrained by the Divide. Smaller topographically controlled rainfall areas emerge also in the winter months but at all times of the year, if large-scale atmospheric rainfall producing features are frequent and well organized, the impact of local topographic units is masked. (Baker-IVI)
W84-02465

REGIONAL DROUGHTS: A STOCHASTIC CHARACTERIZATION,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
M. A. Santos.
Journal of Hydrology, Vol. 66, No. 1-4, p 183-211, October, 1983. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Droughts, *Stochastic process, Probability distribution, Mathematical studies, Water shortages.

A stochastic characterization of regional droughts is offered through a number of random variables (r.v.), called drought characteristics (d.c.). A precise definition of regional droughts was also sought. Regional drought characterization, using probability theory, is made through the study of a number of random variables associated with regional droughts, such as their duration, intensity and the area undergoing drought effects. The distribution, mean value and variance of these random variables, as well as of some other auxilliary variables, are derived theoretically for most of them. Major conclusions were that all the parameters of both the auxilliary variables (a.v.) and d.c. can be obtained from the determinant properties and the critical level and critical area only. Instantaneous deficit-areas have an approximate normal distribution and instantaneous drought-areas have an approximate normal distribution truncated on the left at the critical area. Regional drought durations have a geometric distribution. Total deficits have an approximate exponential distribution. The drought area and the intensity are not correlated with the drought duration. The longer the drought duration the larger the correlation between this d.c. and the total deficit. The longer the drought duration the smaller the correlation between the total deficit and the intensity. (Baker-IVI)
W84-02466

2C. Snow, Ice, and Frost

ROLE OF GLACIERS IN WATER EXCHANGE IN THE USSR,
A. N. Krenke.
Water Resources, Vol. 9, No. 3, p 254-262, May-June 1982. 2 Fig, 2 Tab, 26 Ref. Translated from Vodnye Resursy, No. 3, p 47-56, May-June, 1982.

Descriptors: *Water resources development, *Glaciers, *Water exchange, *USSR, Precipitation, Runoff, Water quality.

The total accumulation of moisture in glacial systems of the USSR during a long term period averages 47.6 cu km/yr and on average for the glaciers the depth of accumulation is 606 mm. To this figure it is necessary to add more than 5 cu km/yr of liquid precipitation falling on glaciers, so that in all about 53 cu km of water per year passes through them. The average time of the water cycle in the glacial systems of the USSR, determined as the ratio of the mass of the glaciers composing them to the annual volume of accumulation, is equal to about 360 years. While the role of glaciers in water exchange is seen as limited, this pertains only to its quantitative characteristics during one year. At any given time much more water participating in the hydrologic cycle is present in glaciers than in river systems or the atmosphere. The qualitative characteristics of glaciers - their low mineralization, large supply of cold, interannual and year-to-year distribution of melting convenient for agriculture - can result in the fact that glacial water is needed for water consumers more demanding of good water quality than is necessary for irrigation. It may become expedient to deliver water along isolated pipelines, precluding the possibility of mixing glacial waters with waters of poorer quality. (Baker-IVI)
W84-02314

2D. Evaporation and Transpiration

OPERATIONAL ESTIMATES OF AREAL EVAPOTRANSPIRATION AND THEIR SIGNIFICANCE TO THE SCIENCE AND PRACTICE OF HYDROLOGY,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Hydrology, Vol. 66, No. 1-4, p 1-76, 1983. 27 Fig, 3 Tab, 86 Ref, 4 Append.

Descriptors: *Evapotranspiration, *Hydrologic models, Estimating, Areal hydrology, River basins, North America, Africa, Ireland, Australia, New Zealand, Climatology.

The conceptual and empirical foundations of the complementary relationship, its use in providing the basis for operational estimates of areal evapotranspiration, the testing of such estimates against comparable water-budget values and the potential use of such estimates to provide the impetus for transforming hydrology from a descriptive to a predictive science are detailed. The most recent version of the complementary relationship areal evapotranspiration (CRAE) models is formulated and documented. The reliability of the independent operational estimates of areal evapotranspiration is tested with comparable long term water budget estimates for 143 river basins in North America, Africa, Ireland, Australia and New Zealand. The practicality and potential impact of such estimates are demonstrated with examples which show how the availability of such estimates can revitalize the science and practice of hydrology by providing a reliable basis for detailed water balance studies; for further research on the development of causal models; for hydrological, agricultural and fire hazard forecasts, for detecting the development of errors in hydrometeorological records, for detecting and monitoring the effects of land use changes; for explaining hydrologic anomalities; and for other better known applications. A tabular summary of literature on complementary relationship is provided along with a schematic conceptual basis for complementary relationship and documentation of complementary relationship models. (Baker-IVI)
W84-02458

OPERATIONAL ESTIMATES OF LAKE EVAPORATION,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Hydrology, Vol. 66, No. 1-4, p 77-100, October, 1983. 9 Fig, 1 Tab, 22 Ref, 1 Append.

Descriptors: *Evaporation, *Lakes, Model studies, Estimating, Predicting, Temperature effects, Humidity, Climatology, Solar radiation, Humidity.

The use of CRLE model to provide operational estimates of shallow lake evaporation from routine observations of temperature, humidity, and sun-

shine duration in the land environment; the development of a routing procedure to take into account the effects of seasonal subsurface heat storage changes in converting estimates of shallow-lake evaporation to estimates of deep-lake evaporation; a test of the results against comparable water budget estimates for eleven lakes in North America and Africa; the development of a procedure for converting lake evaporation to pond evaporation; and ways by which operational estimates of lake evaporation, in combination with operational estimates of areal evapotranspiration, can be applied to problems of water planning and management are reviewed. Descriptions and data sources for ten lakes with water budget estimates of evaporation that are used in the development and testing of the CRLE model are provided. (Baker-IVI)
W84-02459

DIRECT METHOD FOR FOREST TRANSPIRATION MEASUREMENT,
Stavebni Geologie, Prague (Czechoslovakia).
J. Balek, J. Cermak, J. Kucera, and A. Prax.
Journal of Hydrology, Vol. 66, No. 1-4, p 123-131, October, 1983. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Transpiration, *Forest hydrology, Evapotranspiration, Soil water, Water loss, Remote sensing, Aerial photography, Czechoslovakia.

A direct method of transpirational measurement is described which provides very useful values for the water balance simulation of forested watersheds. The simultaneous measurement of meteorological factors and calculations of the potential evaporation during the period of the transpirational measurement indicate a close relationship between the two processes. However, an additional significant factor was the soil moisture regime in the root zone. The availability of water in the saturated zone increased significantly the amount of water transpired during the dry periods and after, while the transpiration of the plant on the soil profile without a saturated zone was much lower. While the transpiration from a forest drawing from an unlimited storage of soil water can reach values close to the potential evaporation, the transpiration from a forest with a less developed saturation zone, or with none at all, is considerably reduced. Formulas so far developed have only regional validity, but a simultaneous evaluation of results from several stands with different conditions can be used for further generalization. The combination of ground observations of transpiration with infrared aerial photography from a low-flying model aircraft provides a solid basis for the extrapolation of the results. (Baker-IVI)
W84-02461

FOREST TRANSPIRATION: A CONSERVATIVE HYDROLOGICAL PROCESS,
Institute of Hydrology, Wallingford (England).
J. Roberts.
Journal of Hydrology, Vol. 66, No. 1-4, p 133-141, October, 1983. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Forest hydrology, *Transpiration, Hydrological models, Europe, Forest understories, Climates, Soil water, Moisture availability, Litter, Stomata.

Information currently available on forest transpiration from studies in European forests is reviewed and the importance of some processes which might tend to equalize transpiration between forests is considered. Four processes are considered as maintaining annual transpiration at similar, rather low, levels. Understoreys are regarded as effective buffers to the canopy differences. To a lesser extent this role can also be filled by the litter layer below trees. A further limit to the level of transpiration is imposed by the interrelationships between two climatic factors, radiation and humidity deficit, both of which influence stomatal behavior and also drive transpiration. While the influence of variations in soil moisture on transpiration would seem at first sight to be important, there is increasing evidence that soil-moisture levels rarely limit transpiration in field-grown trees. It seems probably that where forests exhibit a rather limited daily transpiration loss, perhaps because of the atmospheric humidity/surface resistance feedback, the control of transpiration by available soil water is negligible. Forests, established naturally or artificially, have requirements for water which do not appear to exceed the availability of water at the site in dry years. (Baker-IVI)
W84-02462

2E. Streamflow and Runoff

STREAMFLOW OF THE OCCOQUAN RIVER IN VIRGINIA AS RECONSTRUCTED FROM TREE-RING SERIES,
Geological Survey, Reston, VA. Water Resources Div.
R. L. Phipps.
Water Resources Bulletin, Vol. 19, No. 5, p 735-743, October, 1983. 7 Fig, 6 Tab, 10 Ref.

Descriptors: *Tree-rings, *Streamflow, *Occoquan River basin, Virginia, History, Reconstruction, Low flow, Drought.

Tree-ring indices representing seven sites were used to reconstruct monthly summer streamflow in the Occoquan River basin of northern Virginia from 1841 to 1975. Attempts were made to reconstruct flow for each of the months, April through August. Reconstructions for June, July, and August were judged most reliable. Major midsummer flow minima persisting for more than one year were reconstructed as having occurred in the early 1870's, the early 1930's, and the mid-1960's. Aside from these major dry periods, a greater frequency of extreme low flow during individual years is indicated for the entire record than for the most recent 50 years. (Author's abstract)
W84-02161

PARTIAL DURATION SERIES METHOD REVISITED,
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
L. V. Tavares, and J. E. da Silva.
Journal of Hydrology, Vol. 64, No. 1/4, p 1-14, July, 1983. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Floods, *Variability, Model studies, Flood control, Estimating, Flood recurrence interval, Flood magnitude.

Partial duration series have been used to estimate the relationship of flood magnitude to return period as has the annual maxima method. The relative efficiency of these two methods is evaluated considering separately independent and autocorrelated exceedances. The estimation variance of the flood magnitude associated with a given return period can be underestimated or overestimated by the approximation if the average annual number of exceedances is higher or smaller than 2. The partial duration series method has a significantly lower estimation variance than the annual maxima method if the average annual number of exceedances is greater than 2, assuming that the exceedances can be modelled by a Poisson process and are an i.i.d. sequence of negative exponential variables. The truncation level, L, should be as low as possible providing that the model assumptions are still valid but when L is decreased the hypothesis which is first violated is usually the one regarding the serial independence of the exceedances. (Baker-IVI)
W84-02197

APPLICABILITY OF THE JOHNSON S SUB B -CURVE TO ANNUAL STREAMFLOW DISTRIBUTIONS,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and W.-B. Chow.
Journal of Hydrology, Vol. 64, No. 1/4, p 15-24, July, 1983. 2 Tab, 13 Ref.

Descriptors: *Streamflow, *Model studies, Estimating, Mathematical studies, Method of moments.

The applicability of the Johnson S sub B -curve to the modelling of annual streamflows is evaluated using actual data. The methods for its parameter estimation are summarized and discussed based on the results obtained. The findings after application of the S sub B -curve to 20 sets of annual streamflows with 7 differing alternatives for parameter estimation tend to support the theory that the curve can be used for representing annual streamflow distributions. Although in this study in 3 out of 20 cases the S sub B -curve could not be used, this was due to failures in the methods for parameter estimation rather than by being rejected in the goodness-of-fit test. The method of moments turns out to be the most applicable for the data concerned. Since there are four parameters involved, the first four moments are needed for their estimation. Their estimated values would be subject to large sampling errors, especially when the length of record is short. (Baker-IVI)
W84-02198

EFFECTIVE RECORD LENGTH FOR THE T-YEAR EVENT,
Geological Survey, Reston, VA.
G. D. Tasker.
Journal of Hydrology, Vol. 64, No. 1/4, p 39-47, July, 1983. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Flow, *Estimating equations, Estimating, Flow pattern, Flow characteristics, Groundwater, Channels, Model studies, Design criteria.

The effect of serial dependence on the reliability of an estimate of the T-year event is important in hydrology because design decisions are based upon the estimate. The relative reliability, measured by the effective number of observations, for the T = 2, 10, 20, 50, and 100 yr events as a function of the number of actual observations and the lag-one serial correlation coefficient, is given. These values can be used to help assess the effects of serial dependence on the level of uncertainty in planning decisions based on the T-year event. In addition, replacing actual record length by effective record length may extent the range of applicability of certain network design techniques. A lag-one autoregressive model is assumed with either a normal or Pearson Type-III distribution term. If observations are serially correlated, the effective record length should be used to estimate the discharge associated with the expected exceedance probability. (Baker-IVI)
W84-02200

EFFECT OF MOLE DRAINAGE ON THE HYDROLOGICAL RESPONSE OF A SWELLING CLAY SOIL,
Institute of Hydrology, Wallingford (England).
M. Robinson, and K. J. Beven.
Journal of Hydrology, Vol. 64, No. 1/4, p 205-223, July, 1983. 9 Fig, 1 Tab, 34 Ref.

Descriptors: *Mole drainage, *Clays, Soil properties, Drainage, Soil moisture, Saturated soils, Runoff, Swelling clay soil, Flow, Model studies.

A plot experiment to determine the effects of mole drainage on the hydrological response of a swelling clay soil under pasture is described. The response is very dependent on antecedent moisture conditions, and that higher peak flows may be generated under relatively dry conditions on the (drier) drained plot. This appears to be related to the generation of flows in interpedal macropores supplying water to the mole drains. Under wet conditions, the hydraulic efficiency of the macropores is reduced by swelling of the clay and surface saturation develops on the undrained plot. This results in generally higher peak discharges than from the drained plot. Recession discharges and total water yields are almost always higher from the drained plot. It may be very difficult to detect or model the influence of clay land drainage on river flows. (Baker-IVI)
W84-02209

FLOW NET FOR TWO-DIMENSIONAL LINEARIZED INFILTRATION AND EVAPORA-

TION FROM NONUNIFORM AND NONPERIODIC STRIP SOURCES,
Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering.
V. Batu.
Journal of Hydrology, Vol. 64, No. 1/4, p 225-238, July, 1983. 6 Fig, 11 Ref.

Descriptors: *Unsaturated flow, *Flow nets, *Soil water, Infiltration, Evaporation, Mathematical equations, Fourier analysis, Permeability coefficient.

General analytical expressions are derived for flow nets caused by infiltration or evaporation with random input values from nonuniform and nonperiodic strip sources on the soil surface using the theory of steady unsaturated flow in homogeneous and isotropic porous media. The analysis is based on an exponential relationship between the unsaturated hydraulic conductivity and soil-water pressure, leading to a simple expression for the matrix flux potential and to a linearization of the problem. Fourier analysis is used in the mathematical procedures. The solutions for a uniform infiltration rate from two strip sources and a uniform evaporation rate from an intermediate strip are presented as special cases. The expressions for these special cases have been evaluated using Filon's numerical integration method. Numerical results for these special cases are presented and discussed. (Author's abstract)
W84-02210

WATER MOTION IN A DECIDUOUS FOREST DURING SNOWMELT,
Scarborough Coll., Westhill (Ontario).
A. G. Price, and L. K. Hendrie.
Journal of Hydrology, Vol. 64, No. 1/4, p 339-356, July, 1983. 9 Fig, 2 Tab, 27 Ref.

Descriptors: *Snowmelt, *Runoff, Catchment areas, Unsaturated flow, Vegetation, Snow cover, Snowpack, Deciduous forests, Soil water.

The ways in which snow meltwater moves through a drainage basin were investigated. The function of the unsaturated zone in modulating and transmitting the meltwater pulse was defined. The basin selected for snowmelt runoff research was chosen because of its uniform soil vegetation and snowcover characteristics, and yet, even in this system, variability was high and was reflected in a complexity of process. Indirect measures of soil water motion suggest that subsurface stormflow may occur even in an apparently homogeneous, permeable sand. Even though the pattern of surface water inputs was simple, once this spatially uniform and temporally predictable snowmelt input was imposed on a surface of spatially and temporally predictable variable characteristics, great complexity results. Processes within the unsaturated zone were of primary importance, and their complexity is not eased by conditions occurring during snowmelt. (Baker-IVI)
W84-02214

IDENTIFICATION OF RUNOFF SOURCES OF A FORESTED LOWLAND CATCHMENT; A CHEMICAL AND STATISTICAL APPROACH,
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
For primary bibliographic entry see Field 2K.
W84-02215

PREDICTION OF THE HYDRAULIC REGIME OF RIVERS AND RESERVOIRS,
V. M. Lyatkher.
Water Resources, Vol. 9, No. 6, p 650-675, November-December, 1982. 14 Fig, 88 Ref. Translated from Vodnye Resursy, No. 6, p 118-144, November-December, 1982.

Descriptors: *Flow measurement, *Rivers, *Reservoirs, Mathematical studies, Hydraulics, Fluid mechanics, Flow velocities, Water level, Hydrodynamics, USSR.

The most significant trends in the area of hydrodynamics of rivers and reservoirs are noted for the past 5-10 years in the Soviet Union. In general there has been an intense development in the methods of describing flows in rivers and reservoirs. In the near future it is expected that there will appear program packs permitting the prediction of hydraulic regimes with sufficient accuracy with a small number of empirical constants. At the same time the need is being felt of an expansion of experimental, both laboratory annd prototype, investigations to refine the formulation of the problem with respect both to the selection of mathematical models, boundary conditions being included, and with respect to an objective description of the initial data on the objects being studied. A need for coordinating the efforts of various investigators working in separate but allied directions within the framework of the general problem of hydrophysics of water bodies is noted. (Baker-IVI)
W84-02339

CALCULATION OF CHANNEL FLOWS IN THE PRESENCE OF A REGULATING HYDROELECTRIC SCHEME,
G. P. Epikhov.
Water Resources, Vol. 10, No. 1, p 70-76, January-February, 1983. Translated from Vodnye Resursy, No. 1, p 113-119, January-February, 1983.

Descriptors: *Channel flow, *Hydroelectric plants, *Computers, Mathematical models, Algorithms, Planning, Decision making, Canals, Hydraulic structures.

Many practical problems require the creation of effective methods of calculating channel flows on a computer on the basis of a system of channels and canals in which there are various hydraulic structures for streamflow regulation. An algorithm is presented for accurate computer calculation of channel flows in the presence of a regulating hydroelectric scheme. A system of two consecutive streams between which is located a hydroelectric scheme is examined. To check the performance of the algorithm a hypothetical object with morphologic characteristics similar to the real ones was selected. The hydroelectric scheme is intended to protect river stretches upstream of it from saline seawaters. The results of the numerical experiments showed the good performance of the algorithm and permits recommending it for calculations on real objects. (Baker-IVI)
W84-02347

RELATION OF FIELD STUDIES AND MODELING IN THE PREDICTION OF STORM RUNOFF,
Washington Univ., Seattle. Dept. of Geological Sciences.
T. Dunne.
Journal of Hydrology, Vol. 65, No. 1-3, p 25-48, August, 1983. 6 Fig, 2 Tab, 96 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Snowmelt, Runoff, Storms, Melt water, Storm seepage, Subsurface water, Prediction, Mathematical models, Hydrographs.

Routine methods of predicting strom hydrographs do not require accurate conceptual models of storm runoff processes. Application of hydrology to the analysis of landform evolution and other scientific and land-management problems requires realistic concepts of runoff processes and their variation within drainage basins. These concepts need to be refined, developed, and formalized through more vigorous combination of rigorously designed field experiments and realistically physically based mathematical models. If field studies were routinely designed around a rigorous theory, it is more likely that critical variables waould be measured, which are now usually avoided because of the difficulty of measurement or because the field worker has neither insight into nor interest in their use for modeling to generalize his results. For personnel on the modeling side, there is a need to present models, computational details, and their data requirements more clearly, and to become involved in fieldwork, at least in the planning and data analysis phases. Runoff mechanisms occurring during rainfall are covered along with the special case of runoff generated by these same mechanisms under snowmelt conditions that cause significant differences from runoff generated by rainfall. (Baker-IVI)
W84-02439

SOME PROBLEMS IN TRANSFERRING HYDROLOGICAL RELATIONSHIPS BETWEEN SMALL AND LARGE DRAINAGE BASINS AND BETWEEN REGIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
Journal of Hydrology, Vol. 65, No. 1-3, p 49-72, August, 1983. 11 Fig, 2 Tab, 23 Ref.

Descriptors: *Drainage basins, *Rainfall-runoff relationships, Hydrologic models, Model studies, Drainage, Storms, Storm runoff.

There are problems involved in transferring hydrological relationships between small and large drainage basins and between regions. Basin processes vary considerably from one region to another, and over small distances within one region. These processes include the type and characteristics of storm runoff, small-scale variations of infiltration and runoff, spatial aspects of nonlinear flood response, annual runoff relations and channel transmission losses. Attempts to generalize are thus dangerous, and counter-productive to the wider understanding of processes and the development of valid relationships. Examples are offered of problems in identifying similarity relationships resulting from the interaction of model parameters with basin size, and from random and systematic errors in available hydrological data. There is a need for better knowledge of actual hydrological processes at basin scale. There is a great need to gather data from field observations over a wide range of regions in addition to streamflow and rainfall data currently being collected. Much more information is required on the spatial variations of many hydrological processes. (Baker-IVI)
W84-02440

HYBRID MODEL FOR FLOW FORECASTING ON LARGE CATCHMENTS,
University College, Galaway (Ireland). Dept. of Engineering Hydrology.
J. E. Nash, and B. I. Barsi.
Journal of Hydrology, Vol. 65, No. 1-3, p 125-137, August, 1983. 5 Fig, 5 Tab, 5 Ref.

Descriptors: *Hydrologic models, *Flow measurement, Forecasting, Catchment areas, Seasonal variations, Rainfall-runoff relationships.

On catchments whose flow variations is highly seasonal a simple seasonal forecast for any date, as the mean of the observed flows on that date in previous years, may be better, in the least-squares sense, than a forecast obtained from even a good rainfall-discharge model. The concept of rainfall-discharge has been combined with that of purely seasonal prediction to obtain a better forecast that would be possible to obtain from either method used singly. Data from the W.M.O. Intercomparison is used to test the hypothesis that the rainfall and discharge functions of time expressed as departures from the seasonal means are linearly related. Significantly better results were obtained using this hybrid model than were obtained with the seasonal predictor alone or with an elaborate rainfall-discharge model. Models of this kind may be useful on large catchments exhibiting marked seasonal behavior. (Baker-IVI)
W84-02443

CATCHMENT GEOMORPHOLOGY AND THE DYNAMICS OF RUNOFF CONTRIBUTING AREAS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven, and E. F. Wood.
Journal of Hydrology, Vol. 65, No. 1-3, p 139-158, August, 1983. 10 Fig, 3 Tab, 22 Ref.

Descriptors: *Catchment areas, *Geomorphology, *Runoff, Model studies, Flood frequency, Prediction, Storms, Storm runoff, Flood frequency.

The dynamic nature of areas contributing to runoff is described along with their relationship to the geomorphological structure of catchments. Example calculations are offered which demonstrate that both runoff and flood frequency predictions may be very sensitive to assumptions about the nature of the contributing area. A simple methodology is proposed to predict variable contributing areas on the basis of initial storage deficits, with an extension to allow the prediction of combined surface and subsurface responses. The procedure was applied to four catchments ranging in size from 5 to 456 sq km. This improves on the earlier response model by allowing extension of the contributing area by filling of initial deficits, and also a more explicit treatment of time delays in the unsaturated zone. The results presented demonstrate interaction of the three calibrated parameters in the simplified model but are sufficiently accurate to suggest that the method may be worth further study. (Baker-IVI)
W84-02444

GEOMORPHOCLIMATIC ESTIMATION OF EXTREME FLOW PROBABILITIES,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. R. Cordova, and I. Rodriguez-Iturbe.
Journal of Hydrology, Vol. 65, No. 1-3, p 159-173, August, 1983. 7 Fig, 7 Tab, 7 Ref. Venezuelan National Council for Scientific and Technology grant S1-1212.

Descriptors: *Runoff, *Geomorphology, *Catchment areas, Basins, Flood frequencies, Probabilities, Prediction, Runoff, Storm runoff, Venezuela.

A simple method is developed for estimating flood probabilities, using geomorphoclimatic information. The procedure uses rainfall data and those geomorphologic parameters which were included in the geomorphoclimatic instantaneous unit hydrography. The methodology avoids the coupling of the frequencies in intensity and duration of rainfall with a peak discharge of a certain return period. Such an approach will be extremely useful in regions with great scarcity of streamflow data and moreover may provide further light in the understanding of hydrologic processes at a basin scale. A basin in Venezuela is analyzed in detail and the results are compared with the flood probabilities obtained from the historical streamflow series. The main assumption in this method is that the maximum depth of effective rainfall results in maximum discharge. This is certainly true in the tropics, but there are parts of the world where the maximum rainfall depths are due to convective summer thunderstorms and yield relatively small peak flows, whereas sequences of smaller storms during the spring maintain the soil near saturation and usually yield the peak annual flows. In this case the analysis of maximum depth of rainfall has to be done using the storm events of the rainy season, excluding summer events. (Baker-IVI)
W84-02445

LINEAR CHANNEL AND ITS EFFECT ON THE GEOMORPHOLOGIC IUH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. A. Kirshen, and R. L. Bras.
Journal of Hydrology, Vol. 65, No. 1-3, p 175-208, August, 1983. 10 Fig, 7 Tab, 10 Ref.

Descriptors: *Hydrographs, *Channels, Geomorphology, Linear channels, Boundary conditions, Physiography, Hydrographic models.

The instantaneous unit hydrograph (IUH) is derived as a function of the basin's geomorphological and physiographic characteristics. The response of the individual channels composing the basin are inherent in the basin IUH. Solving the continuity and momentum equations for the boundary conditions defined by the IUH allows one to derive the response of the individual channels. In the derivation of the basins' IUH both the effects of upstream and lateral inflow to the channels are considered. A basis for comparison between the results produced by this model and those produced by a model where the channel's response is assumed to be an exponential distribution is provided by the time to peak and peak response. Such comparisons indicate that if the approach taken herein is accurate then the type of channel response used for the basin's IUH is significant and future efforts must be directed towards parameter estimation. (Baker-IVI)
W84-02446

STABLE-CHANNEL DESIGN IN ALLUVIAL RIVERS,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths.
Journal of Hydrology, Vol. 65, No. 4, p 259-270, September, 1983. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Alluvial rivers, *Channel flow, River beds, Basins, Stability analysis, Channel stability, Sediment discharge, Channel design.

A general problem of stable-channel design is prediction of how a river reach adjusts to transmit imposed water and sediment discharges. A theory of stable-channel design is deduced from the condition that, for any given steady flow, total sediment concentration maintains a balanced average in space and time within a stable channel. This condition for stability applies during changes in channel position but does not constrain them. A stability index is defined in terms of concentration of bed-material load. A channel can be defined as stable if its gross dimensions oscillate about constant values in space and time irrespective of changes in channel position. A quantitative condition for channel stability is that for any specified steady flow and time interval, the temporal mean value of average spatial variation in total sediment concentration within a given channel is constant, independent of alterations in channel alignment. Two distinct stable-channel design methods, threshold and mobile-bed, may be deduced corresponding to zero and constant finite sediment transport rate. Design formulae, given for each method, are applicable to cross-sections or reaches, independent of planform, of both sand-silt and gravel-bed rivers. An expression for pointwise evaluation along a channel of the ratio of bedload to suspended sediment discharge, for a specified steady flow can be inferred. (Baker-IVI)
W84-02449

INFILTRATION AND RUNOFF PREDICTIONS FOR A GRASSLAND WATERSHED,
Oak Ridge National Lab, TN. Environmental Sciences Div.
R. J. Luxmoore.
Journal of Hydrology, Vol. 65, No, 4, p 271-278, September, 1983. 3 Fig, 12 Ref.

Descriptors: *Infiltration, *Runoff, *Grasslands, *Watersheds, Storm runoff, Prediction, Mathematical studies, Hydrologic models, Hortonian equations, Simulation, Chickasha, Oklahoma.

The relative roles of three sources of runoff (direct surface runoff of noninfiltrating water, runoff generated from through fall onto saturated zones in the watershed, and subsurface runoff) in streamflow generation at the R5 watershed at Chickasha, Oklahoma, were simulated using field-determined infiltration characteristics and heterogeneity of soil hydraulic properties derived by a scaling procedure. Several aspects of the simulation predictions are presented to evaluate the suitability of the infiltration data inputs for predicting the hydrologic processes of the R5 watershed. Any discrepancy in Hortonian runoff from the infiltration calculations was compensated for by variable contributing area (VCA) runoff in the hydrologic simulation. Evaluation of the VCA parameterization suggested that contributions of VCA runoff to total streamflow were unreasonably high and that the infiltration parameters overpredicted annual infiltration. Field measurements of infiltration characteristics for hydrologic studies should be obtained during the season with predominant Hortonian runoff. (Baker-IVI)
W84-02450

TIME SERIES ANALYSES OF ANNUAL FLOWS OF AUSTRALIAN STREAMS,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, T. A. McMahon, and J. L. Irish.
Journal of Hydrology, Vol. 66, No. 1-4, p 213-226, October, 1983. 7 Fig, 6 Tab, 11 Ref.

Descriptors: *Time series analysis, *Streamflow, Model studies, Mathematical studies, Australia, Autocorrelation.

Six tests of dependence - autocorrelation, median crossing, turning points, length-of-runs, rank difference and cummulative periodogram - were applied to annual streamflow data for 156 Australian streams. Based on these analyses, about 28% of the streamflow series were found to be non-random. Autocorrelation and partial autocorrelation functions were used to determine the appropriate form of a linear model for each stream. Procedures for identifying suitable models for those sites which appear to have a clearly non-random sequence of annual streamflow are outlined, and a priori choice of appropriate model type is indicated for each of the sites whose streamflow data exhibit significant short-memory persistence. For most sites in Australia, and for most applications meriting simulations of annual streamflow records, a first-order autoregressive scheme is either required to fit the data, or represents a significant improvement over a white noise model. For about one site in six, a higher order autoregressive model, a moving average model, or a mixed autoregressive moving average model is indicated. (Baker-IVI)
W84-02467

ANNUAL VARIATIONS OF GROUND AND STREAMFLOW TEMPERATURES IN SMALL FORESTED VALLEYS,
Oita Univ. (Japan). Dept. of Earth Science.
H. Kawanishi.
Journal of Hydrology, Vol. 66, No. 1-4, p 253-267, October, 1983. 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Forest hydrology, *Water temperature, Ground temperature, Streamflow, Model studies, Heat transfer, Valleys, Groundwater movement, Topography, Mathematical models.

A two-dimensional numerical model was developed to evaluate the effects of topography and groundwater flow on the annual variations of ground temperature in a forested valley. Heat exchange on the forest floor was discussed on the basis of the observed data. Surface water temperature was computed from the ground temperature field in a valley bottom, taking into account the effect of heat transport by the running water. The rate of heat exchange on the forested floor was shown to be proportional to the difference between air and ground surface temperatures. Ground temperature in a valley bottom is greatly affected by the topography and the streamflow, and to only a small degree by the groundwater flow. Surface water temperature was computed from the ground temperature field in a valley by assuming a smaller rate of heat exchange in the bottom than on the slopes. (Baker-IVI)
W84-02470

OBSERVATIONS ON THE TIME OF TRAVEL OF WAVES IN THE RIVER SKERNE, ENGLAND, AND THE EFFECT OF AQUATIC VEGETATION,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
L. Hamill.
Journal of Hydrology, Vol. 66, No. 1-4, p 291-304, October, 1983.

Descriptors: *Solitary waves, *River Skerne, *England, *Vegetation, Aquatic plants, Aquatic weeds, Seasonal variation, Mine drainage, Path of pollutants, Time of travel.

The water pumped from mine workings during periods of cheap off-peak electricity formed a series of relatively uniform solitary waves in the River Skerne. The passage of the waves was recorded at three river gauging stations during 1973 and 1974. The analysis indicates that in some circumstances the time of travel of waves may be increased significantly during the summer months, and may follow an annual cycle as a result of weed growth in the river channel. Although it is difficult to define quantitatively the increase in travel time that will occur in a particular situation, it can be considerable. The correction factor will vary seasonally also and will not have a constant value as assumed by others. To study effectively the time of travel of a pollutant, a series of radiotracer surveys would be needed at different times of the year. Instead of a radiotracer survey the observed velocity of flood waves can be used to assess the time of travel. However, unless the flood waves are frequent and consistent, considerable errors could be incurred. The effect of seasonal weed growth in the river channel must be considered. The claim that from one time of travel survey at low flows and one set of hydrolgical records at a number of gauging stations along the river the times of travel of pollutants can be calculated under a range of flow conditions is unjustified. (Baker-IVI)
W84-02472

BUILDUP OF DISCHARGE ALONG THE COURSE OF A MOUNTAIN STREAM DEDUCED FROM WATER-QUALITY ROUTINGS (EC ROUTINGS),
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
C. A. J. Appelo, R. Becht, A. A. Van de Griend, and T. C. M. Spierings.
Journal of Hydrology, Vol. 66, No. 1-4, p 305-318, October, 1983. 7 Fig, 1 Tab, 28 Ref.

Descriptors: *Water quality, *Mountain streams, *Stream discharge, Italy, Alps, Conductivity, Runoff, Catchments, Hydrology.

Changes in electrical conductivity (EC) were examined along the course of a high mountain stream in the northern Italian Alps. The EC of water contributing to the stream varies with the lithology drained, thus permitting a chemical gauging of contributing area. Recognition of small changes in discharge is possible using EC routing of the stream. A rapid semi-quantitative insight is thus provided into the buildup of runoff production from various parts of the catchment under different hydrological conditions. The method is seen as a valuable tool for the recognition of different contributing areas. When conditions are favorable it can show the response of sub-areas to changing hydrological conditions. The method may thus contribute to a practical realization of the partial contributing area concept in hydrology. (Baker-IVI)
W84-02473

APPLICATION OF FLOW MODELS IN AN ALPINE CATCHMENT AREA USING TRITIUM AND DEUTERIUM DATA,
Institut fuer Radiohydrometrie der Gesellschaft fuer Strahlen-und Umweltforschung, Munich (Germany, F.R.).
P. Maloszewski, W. Rauert, W. Stichler, and A. Herrmann.
Journal of Hydrology, Vol. 66, No. 1-4, p 319-330, October, 1983. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Hydrologic models, *Runoff, *Flow, *Alpine regions, *Tritium, *Deuterium, Precipitation, Lainbach Valley, Bavarian Alps, West Germany, Basins, Catchment basins, Groundwater storage.

Measurements of tritium and deuterium concentrations in precipitation and runoff were in addition to conventional investigation methods used to provide some further insight into the storage properties of Lainbach valley, a catchment area of 18.7 sq km and 670 to 1801 m above sea level in the Bavarian Alps. Different simple hydrological models were used to model the basin. The application of specific flow models to the isotopic output data was employed to derive information about mean transit times of subsurface water and storage volumes of basin reservoirs. Based on fitted mean transit times of 0.8 years for the upper subsurface reservoir and 7.5 years for the lower subsurface reservoir, storage volume equivalents were obtained of 0.6 and 1.9 m of water depth, respectively. The estimates obtained of mean residence times of groundwater and its storage volumes, based on measurements of environmental isotopes and their interpretation by flow model computations, seem to be realistic. The results are supported by the agreement obtained from using two isotopes with different origin and input functions, even though the degree of accuracy of the results can hardly be evaluated. It is desirable to have more detailed hydrogeological information for an independent evaluation of the subsurface storage capacity. The example showed that a refined treatment of the hydrological problem by modeling can be founded on both tritium and deuterium measurements. (Baker-IVI)
W84-02474

2F. Groundwater

NUMERICAL MODELING OF SALTWATER INTRUSION IN THE NORTHERN GUAM LENS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
D. N. Contractor.
Water Resources Bulletin, Vol. 19, No. 5, p 745-751, October, 1983. 9 Fig, 10 Ref.

Descriptors: *Saline water intrusion, *Mathematical models, *Northern Guam lens, *Groundwater level, Pumping, Groundwater management, Geohydrology, Groundwater recharge, Phreatic surface.

The two-dimensional finite element saltwater intrusion model (SWIGS2D) has been applied to the Northern Guam lens. The Northern Guam lens was discretized into 299 linear, triangular elements and 189 nodes. The model was calibrated using 1978 hydrologic data. The output of the model was compared with measured water levels in six observation wells. The calibrated values of permeability and porosity were then used to verify the model using 1979 data. A calibrated and verified model can be used to make an infinite variety of management and planning studies. Three applications are provided that would be considered typical management runs. Steady state runs were made to compare the four conditions of no pumping, 1978 pumping levels, twice 1978 pumping levels, and five times 1978 pumping levels. There were only minor changes in water levels and aquifer volumes for the first three pumping rates, but significant changes did occur for five times the 1978 pumping rate. The effect of zero recharge to the aquifer was demonstrated for the pumping levels existing during 1978. During the dry months of the year, the water levels in wells are controlled by the sea level changes; in the rainy months the water levels respond to the recharge. The final run shows how long the aquifer takes to reach steady state when the pumping rate is increased from the 1978 pumping level to twice that value. The pumping rate was doubled and the unsteady changes in the phreatic surface and the interface elevation were studied. The phreatic surface declines substantially in a short period of time and then declines at a much lower rate to its final steady value. The interface moves much more gradually over a much longer period of time. The program can be used for numerous other studies for management and planning purposes. (Moore-IVI)
W84-02162

NUMERICAL MODEL DESCRIBING UNSTEADY FLOW IN A FRESH WATER LENS,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers, and H. L. Vacher.
Water Resources Bulletin, Vol. 19, No. 5, p 785-792, October, 1983. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Unsteady flow, *Freshwater lens, *Islands, *Groundwater recharge, Mathematical models, Geohydrology, Somerset Island, Bermuda.

A two-dimensional numerical model is developed to simulate the water table configuration under unsteady flow conditions (variable recharge) for a small coastal or oceanic island of any shape. The model is based on the Ghyben-Herzberg principle and the Dupuit assumptions. Finite difference equations are formulated from the governing flow equation and solved by the iterative alternative-direction-implicit procedure. The resultant tri-diagonal matrices are resolved utilizing the well known Thomas algorithm. Somerset Island, one of the six main land masses of Bermuda, is the prototype. The island is approximately 6 sq km in area and is underlain by a freshwater lens. Recharge to the island is derived from rainfall. Application of the model to the undeveloped fresh water lens of Somerset Island produced results in very good agreement with field observations and previously estimated hydrogeologic parameters. The model appears to be a viable means of predicting the response of a Ghyben-Herzberg lens to current, expected, or proposed hydrologic stresses such as variable recharge. Some caution is needed when interpreting model results for field cases where the water table fluctuations are rapid or where the thickness of the transition zone is great. (Moore-IVI)
W84-02168

EFFICIENT PROCEDURE IN THE DIGITAL SIMULATION OF AQUIFER SYSTEMS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and R. V. S. S. Avadhanulu.
Journal of Hydrology, Vol. 64, No. 1/4, p 159-174, July, 1983. 4 Fig, 5 Ref, 1 Append.

Descriptors: *Aquifers, *Simulation analysis, Digital computers, Computers.

The simulation of complex aquifer systems by interative solutions of the relevant equations involves the estimation and storage of several intermediate arrays of numbers. These occupy extensive memory and large storages. This has necessitated the development of an optimization which is efficient in terms of memory required. The program code developed for the technique is tested using a strongly implicit procedure on a two dimensional aquifer system. The results showed a saving of about 98% in the core memory utilization. (Author's abstract)
W84-02206

ANALYSIS OF DUG-WELL TEST DATA,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
S. P. Rajagopalan.
Journal of Hydrology, Vol. 64, No. 1/4, p 175-188, July, 1983. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Hydraulic gradient, *Wells, *Mathematical models, Discharge hydrographs, Model studies, Drawdown, Water supply development, India.

Test data from dug wells is analyzed. A mathematical model is presented with the boundary condition along the well face being defined on the basis of alternative assumptions made on how the radial hydraulic gradient is distributed over the well face. Approximate equations for the recovery phase are obtained based on an additional assumption that the radial hydraulic gradient along the well face is linearly related to the drawdown in the dug well. The use of these equations leads to the determination of a parameter of the form PrB (where Pr is the lateral permeability of the aquifer and B is a constant) and of the time required for the dug well to recoup fully. A simple field test procedure is adopted to obtain conditions of different discharges from the well and an empirical relationship between the parameter PrB and the well discharge is established for the test well site. The approximate equations that are developed also find use in

correcting some of the common anomalies in the abstraction phase data. (Baker-IVI)
W84-02207

CONCEPTUALIZATION OF A MODEL FOR THE MOVEMENT OF POLLUTION IN AN AQUIFER - APPLICATION TO THE RHINE GRABEN (CONCEPTION D'UN MODELE DE PROPAGATION DE POLLUTION EN NAPPE AQUIFERE - EXEMPLE D'APPLICATION A LA NAPPE DU RHIN),
Bureau de Recherches Geologiques et Minieres, Strasbourg (France). Service Geologique Regional Alsace.
For primary bibliographic entry see Field 5B.
W84-02212

MODELLING OF HYDROLOGIC PROCESSES IN A SMALL NATURAL HILLSLOPE BASIN, BASED ON THE SYNTHESIS OF PARTIAL HYDROLOGICAL RELATIONSHIPS,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W84-02213

CORRELATION MODEL FOR CALCULATING GROUNDWATER LEVEL RESPONSES IN THE SISHEN NORTH MINE,
Department of Environmental Affairs, Pretoria (South Africa). Div. of Geohydrology.
J. Willemink.
Water South Africa, Vol. 9, No. 3, p 103-109, July, 1983. 7 Fig, 6 Ref.

Descriptors: *Aquifers, *Mine drainage, Drawdown, Groundwater level, Hydrographs, Pumping, Model studies, Depression head, Observation wells, Sishen, South Africa.

Due to a lack of observation wells and geohydrological knowledge at greater distances from the center of pumping in a mine where groundwater is abstracted on a large scale for dewatering purposes, it is not always possible to delineate the aquifer and to establish the spreading of the depression cone of dewatering. Consequently, it will be impossible to make a fairly good assessment of the groundwater supply. A method has been developed to calculate the future drawdown of the groundwater level inside the mine, which reflects the depletion of the groundwater supply, by correlating the variable daily pumping figures and the measured groundwater level responses. The application of this computation method is illustrated by the dewatering of the Sishen North Mine (South Africa). (Author's abstract)
W84-02310

LONG-TERM VARIATIONS OF GROUNDWATER RESOURCES OF THE NORTHERN HEMISPHERE,
R. K. Klige, and V. S. Kovalevskii.
Water Resources, Vol. 9, No. 3, p 263-271, May-June, 1982. 6 Fig, 1 Tab, 23 Ref. Translated from Vodnye Resursy, No. 3, May-June, 1982.

Descriptors: *Groundwater, *Water resources, *Groundwater recharge, Replenishment, Natural recharge, Water balance, USSR, Northern hemisphere, Groundwater depletion, Groundwater runoff.

To study the long term trend of recharge of groundwater resources, data was used of the indicated observations for the territories of the USSR, Europe, and the USA. The chronological runoff series were obtained on the basis of the mean monthly discharges of comparatively small rivers mainly for the winter low water period during which rivers are fed primarily by groundwaters. The data of more than 1000 gauging stations with a duration of observations from 15 to 80 years with the bulk of the series having a duration of 25-40 years were used for analyzing the groundwater regime. In the Leningrad region, Baltic region, Belorussia, and central regions of the RSFSR a distinct trend toward depletion of groundwater resources is noted in recent decades against the background of a periodic alternation of individual groups of dry and wet years. An analogous picture is found in the Maritime territory, Novosibirsk and Omsk regions, Georgia, and on the greater part of the territory of Kazakhstan. A trend toward an increase of groundwater resources was noted in some other areas including the southern Ukraine, Middle Volga Land, Ciscaucasia, and a number of regions of Central Asia, Kazakhstan, and Eastern Siberia. (Baker-IVI)
W84-02315

PREDICTION OF GROUNDWATER RESOURCES OF FOLD REGIONS ON THE BASIS OF STUDYING THE EVOLUTION OF ROCK PERMEABILITY,
B. E. Antypko.
Water Resources, Vol. 9, No. 4, p 370-380, July-August, 1982. 3 Fig, 1 Tab, 16 Ref. Translated from Vodnye Resirsy, No. 4, p 48-59, July-August, 1982.

Descriptors: *Groundwater basins, *Permeability, *Rocks, Mountains, Basins, Hydrogeology, Water storage, Groundwater storage, Seepage, Soil properties, Geologic history.

Some regional aspects of the formation and evolution of porosity and permeability of rocks in fold-mountain regions and basins within their limits are examined. In these regions the permeability of rocks is regarded as a complex function depending on such factors as the genesis of the rocks, evolution of sedimentary rocks in various stages of progressive lithogenesis, regional metamorphism of rocks during geosynclinal folding and orogenesis, local metamorphism with manifestations of volcanism and tectonic disturbances in postfolding epochs, and subsequent disintegration under the effect of tectonic forces and in the zone of hypergenesis. Fold systems differ from one another by the number of phases of development and time of their completion. In conformity with the folding phases three principal rock complexes are distinguished in their structure. The first complex is rocks of the ancient folded basement on which the given system was formed. The second is the main geosynclinal complex of the given system, represented by sedimentary and volcanic rocks which during development of the geosynclinal trough were repeatedly subjected to complex folding, intrusions and extrusions of magma and as a result were uplifted as mountain structures. The third, or orogenic structural stage, is related to the formation of intermontane basins and foredeeps accompanying uplifting of the geosyncline at the final phase of its development. On the basis of the relations established between the degree of lithification of sedimentary rocks composing fold-mountain regions and their structural tectonic history, a map has been compiled of the lithogenesis and permeability of rocks for these regions. (Baker-IVI)
W84-02320

DISTRIBUTION OF FRESH GROUNDWATERS IN THE EARTH'S INTERIOR,
N. A. Marinov.
Water Resources, Vol. 9, No. 4, p 380-387, July-August, 1982. 10 Ref. Translated from Vodnye Resursy, No. 4, p 60-68, July-August, 1982.

Descriptors: *Groundwater potential, *Drinking water, *Distribution, Semiarid regions, Arid regions, Permafrost, Geohydrology.

Freshwater resources are not as vast as one might imagine, amounting to 2-3% of all the water, salt and fresh, combined. The main structural formations of the earth's crust containing fresh groundwaters are fold-mountain regions, or hydrogeological massifs, platform and intermontane artesion basins, faults, and shelf zones of seas and oceans. Groundwater recharge of fold-mountain regions is accomplished mainly by infiltration of precipitation, condensation of moisture from air and melting of glaciers. The formation of fresh groundwaters and the regularities of their distribution in water-containing rocks of highlands are extremely complex and depend on many factors. Groundwater discharge is accomplished by evapotranspiration, the drainage system, and flow into adjacent artesian basins. The role of fresh groundwaters of hydrogeological fold regions in solving the problems of drinking water supply is small. In humid regions groundwaters are as a rule sufficient for domestic water supply and other needs. In arid and semiarid regions, fresh groundwaters are insufficient. They are also insufficient on large expanses in the permafrost region. The major cause of groundwater depletion is pollution. One of the main conditions of conservation of fresh groundwater resources will be their protection from depletion and pollution. (Baker-IVI)
W84-02321

USE OF FACTOR ANALYSIS FOR REGIONALIZING FOLD-MOUNTAIN REGIONS BASED ON CONDITIONS OF FORMATION OF THE GROUNDWATER RUNOFF,
B. I. Pisarskii, and A. P. Khaustov.
Water Resources, Vol. 9, No. 4, p 388-395, July-August, 1982. 4 Tab, 30 Ref. Translated from Vodnye Resursy, No. 4, p 69-76, July-August, 1982.

Descriptors: *Groundwater runoff, *Mountains, *Factor analysis, Water supply development, Fold mountains, Distribution, Mapping, Mongolia, USSR.

The regularities of the distribution and formation of the groundwater runoff in the Mongolo-Baikalian orogenfold system are considered, including Lake Baikal region, a considerable part of the trans-Baikal region, and the mountainous regions of Northern Mongolia. The first stage of the study consisted of small scale mapping and regional evaluation of natural groundwater resources and their distribution with respect to aquifer systems and formations. The second stage included regime observations and experimental works on representative river basins, making it possible to establish zonation in the distribution of groundwater runoff and to estimate the portion of its individual components and value of the main parameters of the groundwater runoff of various probabilities. The calculations of the principal and indirect indices determining the conditions of formation of groundwater runoff and the construction of a factor model have made it possible on the basis of a limited number or direct parameters (rate of groundwater runoff and coefficient of groundwater feeding and runoff) to accomplish medium-scale mapping of the groundwater runoff and to give an estimate without conducting long and costly field investigations and regime observations. (Baker-IVI)
W84-02322

USE OF HEAVY OXYGEN ISOTOPE CONCENTRATIONS WHEN STUDYING GROUNDWATERS OF KARSTIFIED CARBONATE ROCKS OF THE CRIMEAN MOUNTAINS,
Yu. B. Seletskii, V. D. Pribluda, V. A. Polyakov, N. V. Isaev, and A. V. Yakubovskii.
Water Resources, Vol. 9, No. 4, p 404-408, July-August, 1982. 1 Fig, 2 Tab, 11 Ref. Translated from Vodnye Resursy, No. 4, p 85-90, July-August, 1982.

Descriptors: *Groundwater recharge, *Karst hydrology, Geohydrology, Carbonates, Rocks, Soil properties, Oxygen, Precipitation, Residence time, Oxygen isotopes, Crimean Mountains, USSR.

Problems of groundwater formation were examined in one of the karstified regions of the Crimean mountains. The accepted fact that the content of stable hydrogen and oxygen isotopes in precipitation decreases with increases of height above sea level at which it falls was used as the basis for this study. The results obtained allowed the establishment of altitudinal isotope gradients for precipitation of the southern and northern slope; the confirmation of the dominant role of groundwater recharge at high elevations; the establishment of a greater residence time of groundwater in the hydrogeological systems of the southern slope compared to the northern slope; and the observance of a predominantly winter recharge of all investigated types of groundwaters and its greater role for the

southern slope than for the northern slope. Thus this first experience of using O-18 concentration for solving certain important problems of the hydrogeology of the Crimean mountains demonstrated the prospects of using natural isotopes as a tracer when investigating conditions of groundwater formation in karstified massifs. (Baker-IVI)
W84-02323

INVESTIGATION OF GROUNDWATER EXCHANGE PROCESSES IN THE BALTIC ARTESIAN BASIN,
V. G. Onufriev, A. V. Meskheteli, Yu. L. Ob'edkov, N. B. Anosova, and V. V. Romanov.
Water Resources, Vol. 9, No. 5, p 530-535, September-October, 1982. 2 Tab, 3 Ref. Translated from Vodnye Resursy, No. 5, p 123-128, September-October, 1982.

Descriptors: *Groundwater exchange, *Water exchange, *Baltic Artesian Basin, Artesian basins, Aquifers, Water supply, Radioisotopes.

A determination of the temporal characteristics of water exchange processes is important for establishing regularities of the formation of groundwaters. The Baltic artesian basin occupies an area of about 214000 sq km and completely encompasses Estonia, Latvia, and Lithuania, the Kaliningrad Region of the RSFSR, northern regions of the Belorussian SSR, and a part of Poland. In a geological structural aspect, the Baltic artesian basin belongs to the northwestern part of the Russian platform. Two hydrogeological series separated by a Cambrian clay stratum are clearly distinguished in the section of the sedimentary mantle. The Sventoji-Tartu aquifer system, having paramount importance for operating and prospective water supply, is developed within 60% of the entire area of the Baltic artesian basin. The system is represented by strata of fine- and medium-grained sands or sandstones and siltstones, including from 10 to 50% lenticular-occurring variegated clays. The water content of the rocks varies considerably both over the area of their distribution and in the section. About 30 determinations of the C-14 and T content in groundwaters of the Baltic artesian basin were carried out to study water exchange processes. The possibility of using radiocarbon and tritium for determining the portion of waters of different origin and travel time of waters in various regions of the basin was shown with reference to the groundwaters of the Baltic artesian basin. (Baker-IVI)
W84-02330

TRITIUM AND OXYGEN-18 IN NATURAL WATERS OF THE NORTHEASTERN CASPIAN REGION,
R. K. Shakhnova, V. V. Romanov, V. S. Brezgunov, and I. K. Morkovkina.
Water Resources, Vol. 9, No. 5, p 536-545, September-October, 1982. 3 Fig, 1 Tab, 7 Ref. Translated from Vodnye Resursy, No. 5, p 129-139, September-October, 1982.

Descriptors: *Groundwater recharge, *Radioisotopes, Tritium, Oxygen radioisotopes, Tritium, Caspian regions, Natural waters, Precipitation, Groundwater movement.

Isotopic characteristics of natural waters of the northeastern Caspian region were used to study the hydrodynamic conditions in the upper sedimentary strata of a section up to 100 m thick. The region under study included the Ural River valley in its meridional course, marginal northeastern part of the Caspian lowland, and the cis-Syrt spurs. The region is characterised by an arid climate, resulting in a deficit of surface waters and specific features of the relief complicated by the development of many meso- and microforms. Comparatively low values of tritium (T) and oxygen-18 (O-18) concentrations were noted in precipitation and river waters. Substantial differentiation of T concentrations was noted in river waters depending on the size of the rivers. Decreases of isotopic concentrations were seen in waters of small rivers from the upper reach to the mouth. Substantial increases were noted in T and O-18 concentrations in waters of lakes compared to river waters. A general trend toward a decrease of T and O-18 concentrations from surface waters and precipitation to groundwaters was noted. Within the region there is no unified groundwater flow, except the groundwater flow in the alluvial deposits having a lateral resultant direction. There is no regular recharge of lenses of fresh and slightly brackish waters in marine and eolian Quaternary deposits. The recharge of groundwaters by river waters occurs only within alluvial valleys of comparatively large rivers of the region. (Baker-IVI)
W84-02331

STUDY OF THE SULFUR ISOTOPIC COMPOSITION OF GROUNDWATERS FOR SOLVING HYDROGEOLOGICAL PROBLEMS (WITH SPECIAL REFERENCE TO THE CHU-SARYSU ARTESIAN BASIN),
G. M. Shor, M. N. Golubchina, N. I. Komarova, R. E. Prilutskii, and A. I. Toksubaev.
Water Resources, Vol. 9, No. 5, p 550-556, September-October, 1982. 6 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No. 5, p 145-152, September-October, 1982.

Descriptors: *Groundwater, *Hydrogeology, Sulfates, Sulfur isotopes, Infiltration, Artesian basins, Geochemistry, Chu-Sarysu Artesian Basin, Kazakhstan, USSR.

The sulfur isotopic composition of sulfate in the formation waters of the Upper Cretaceous-Eocene strata of the central part of the Chu-Sarysu artesian basin in southern Kazakhstan (USSR) has been studied for more than 10 years. The results of the study can be used when solving the following specific problems: establishment of the sites of recharge of flows of present day infiltration waters; establishment of the characteristics of formation of fresh calcium and sodium-calcium waters localized in the sphere of influence of the main and secondary recharge areas of infiltration flows; establishment of the conditions of formation of saline sodium chloride-sulfate and sodium sulfate-chloride waters; evaluation of the possibility of the participation of biogenic processes in the formation of the chemical composition of groundwaters; and the establishment of the role of biogenic processes in the formation of soda-type groundwaters having special technical and irrigation properties. (Baker-IVI)
W84-02332

RADON SURVEY DETECTION OF SUBMARINE GROUNDWATER DISCHARGE ZONES,
P. A. Kir'yakov, G. V. Lisichenko, V. A. Emel'yanov, and A. Yu. Mitropol'skii.
Water Resources, Vol. 9, No. 5, p 557-561, September-October, 1982. 3 Fig, 1 Tab, 10 Ref. Translated from Vodnye Resursy, No. 5, p 153-157, September-October, 1982.

Descriptors: *Groundwater movement, *Radon, Submarine springs, Black Sea, Crimea, USSR, Water supply, Groundwater discharge.

The submarine discharge of fresh groundwaters in the shelf zone and continental slope of the Black Sea coast of Crimea was examined for water supply purposes. Two zones were selected for study. The first had previously known submarine discharges of fissure-karst waters. In the second zone the presence of such discharges was only assumed. The radon content in springs on the shore and in the sea were measured simultaneously along marked profiles to determine the background values of radon. The determination of groundwater discharge is possible not only under conditions of rivers but also in the sea. A decrease was also noted in salinity in the bottom layer of seawater, which was caused by submarine discharge of groundwaters contained in the alluvial deposits of the Voron River valley. The radon method is most effective under conditions of concentrated discharges. The use of this method together with hydrochemical, hydrodynamic, and thermometric investigations will permit a more effective estimation of submarine groundwater discharge. (Baker-IVI)
W84-02333

GROUND WATER AND THE EVOLUTION OF PATTERNED MIRES, GLACIAL LAKE AGASSIZ PEATLANDS, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel.
Journal of Ecology, Vol. 71, No. 3, p 913-921, November, 1983. 3 Fig, 33 Ref.

Descriptors: *Groundwater movement, *Bogs, *Mire complexes, *Peat bogs, *Glacial Lake Agassiz, Minnesota, Computer models, Hydrogen ion concentration, Groundwater mounding, Fens, Wetlands, Geohydrology.

The hydrogeological setting of the Glacial Lake Agassiz Peatlands in Minnesota was investigated by measuring ground-water levels in observation wells, by studies of soil types and thicknesses, and by computer model experiments to simulate ground-water flow. Most ground water circulates along flow paths several kilometers long that pass through the peat column and into the underlying mineral soil. Most ground-water flow is probably caused by the development and persistence of large raised bogs, and occurs because of groundwater mounds (elevated water tables) under the bogs. Lateral bog growth may be limited by the neutralizing of bog water acidity by ground-water discharge ('artesian' flow) at raised bog margins. (Author's abstract)
W84-02401

EFFECT OF SPATIAL VARIATION IN HYDRAULIC CONDUCTIVITY ON GROUNDWATER FLOW BY ALTERNATE SOLUTION TECHNIQUES,
Birmingham Univ. (England). Dept. of Civil Engineering.
N. T. Kottegoda, and G. C. Katuuk.
Journal of Hydrology, Vol. 65, No. 4, p 349-362, September, 1983. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Groundwater movement, *Permeability coefficient, *Spatial distribution, Flow, Monte Carlo method, Permeability, Seepage, Drainage, Aquifer properties, Simulation, Statistical methods.

The behavior of an aquifer in which there is spatial variation in hydraulic conductivity is simulated by means of a Monte Carlo procedure. A second approach uses finite-difference methods to quantify the variance in potential head and flow through an aquifer. In the first method the lognormal function is used to model the distribution of conductivities. Thus variations in hydraulic head and specific discharge are studied. In the alternate technique the standard deviation of two-dimensional flows is related to the standard deviation of conductivity. Hence, an empirical probability distribution of flows is obtained by specific values of the variance in conductivities. Uncertainty concerning the predicted hydraulic head was dependent on the degree of non-uniformity in hydraulic conductivity as measured by its standard deviation. The variation in two dimensional flow in a confined medium was greater than the variation in hydraulic head, espcially for a medium with high conductivity values. A probability distribution of groundwater flows, in a medium with random lognormal conductivities was obtained by experimental methods. There was no particular benefit in using random walk procedures over numerical methods. In fact, finite-difference procedures took less computer time because the alternate solution technique required large sets of random numbers to obtain comparable results. However, more complicated three-dimensional analyses may be advantageously tackled by Monte Carlo methods. (Baker-IVI)
W84-02455

RECHARGE TO FINITE AQUIFERS FROM STRIP BASINS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
N. H. Rao, and P. B. S. Sarma.
Journal of Hydrology, Vol. 66, No. 1-4, p 245-252, October, 1983. 3 Fig, 7 Ref.

Descriptors: *Aquifer recharge, *Recharge basins, *Groundwater recharge, Mathematical studies, Model studies, Aquifer characteristics, Basins, Recharge, Fourier analysis.

The problem of groundwater recharge from strip basins to finite aquifers is solved analytically by the method of finite Fourier transforms. Analytical solutions were derived for the profiles of water table mounds resulting from recharge over a strip basin to a finite aquifer for two different types of aquifer boundaries, namely, open-water-body boundaries, and impermeable boundaries. The results compare favorably with those experimental results conducted in sand tank models. The water table profiles predicted by the proposed theory agree with the experimental results and with the numerical solutions and are better than an earlier linearized analytical solution. (Baker-IVI)
W84-02469

2G. Water In Soils

ESTIMATION OF SOIL MOISTURE FROM SEASAT SAR DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
B. J. Blanchard, and A. T. C. Chang.
Water Resources Bulletin, Vol. 19, No. 5, p 803-810, October, 1983. 10 Fig, 14 Ref. DOC contract M09-A01-78-00-4332, NASA grant NSG5-134.

Descriptors: *Soil water, *Radar, *Satellite technology, Remote sensing, Crops, Tillage, Vegetation, Synthetic Aperture Radar, Seasat.

A study was made to determine if Seasat Synthetic Aperture Radar (SAR) data could be used to make practical estimates of soil moisture. Extensive ground measurements were collected at two primary sites near Guymon, Oklahoma, and Sublette, Kansas. The relative sensitivity of the SAR to differences in soil moisture, tillage roughness, and vegetation was determined. To validate the effects detected in the SAR data, an airborne scatterometer with a similar wavelength was flown repeatedly over the Guymon site. Soil moisture variations in the surface 2 cm and surface 15 cm of fields with bare soil, milo and alfalfa produce similar responses in the scattering coefficient from both systems. Roughness due to tillage in row crops produced as much as 12-15 dB increase in the scatterometer return. Most agricultural vegetation was effectively penetrated by the L-band frequencies; however, corn produced an exceptionally high radar return either standing or after combine harvesting. When corn had ripened, there was some evidence that tillage roughness could be detected through the canopy. Moderate tillage roughness produced by grain drill furrows caused over 12 dB increase in return when row directions changed from parallel to perpendicular with respect to the SAR look direction. Dramatic increases in return occurred when vegetation surfaces were wet. Increased radar returns from tillage roughness, some vegetation and wet vegetation surfaces, all dynamic in nature, were significant and may limit the practical estimation of soil moisture from the radar data. (Author's abstract)
W84-02170

EFFECT OF SUBSOIL CONDUCTIVITY AND THICKNESS ON INTERFLOW PATHWAYS, RATES AND SOURCE AREAS FOR CHEMICALS IN A SLOPING LAYERED SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, and J. D. Ross.
Journal of Hydrology, Vol. 64, No. 1/4, p 189-204, July, 1983. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Saturated flow, *Soil properties, Permeability coefficient, Infiltration, Conductivity, Seepage lines, Transport, Fate of pollutants.

The effects of relative hydraulic conductivities and thickness of topsoil and subsoil layers and leakage rate of a compact base material on the saturated steady water flow through a sloping soil to an outflow face (interflow) were investigated theoretically. The water was assumed to be supplied from the surface, enough to keep the entire soil saturated. Simplified descriptions of the interflow characteristics were sought. A Gram-Schmidt orthonormalization procedure provided a potential-theory solution of the problem, even though the outflow seepage face existed over two soil layers. For a nonlayered soil two regions of water entry and flow could be distinguished when the base material was not leaky: flow in the main body of soil (region 1); and additional infiltration and flow near the seepage face (region 2). For a (slope length) / (soil depth) ratio of 20 or greater, the flow in region 1 could be approximated as a one-dimensional flow downslope in each soil layer. The length of slope that contributed to flow in region 2 was linearly related to the ratio of the hydraulic conductivity of the subsoil to that of the topsoil. A subsoil of higher conductivity than that of the topsoil increased several fold the rate of infiltration and interflow and the soil (both topsoil and subsoil) volume that was traversed by interflow near the seepage face. It also increased the area and rates of water entry and flow through the topsoil near the upper end of the slope. The transport of topsoil chemicals to field runoff will be speeded up from certain, now predictable, portions of the slope length. When the underlying base material was leaky, some water entering the soil surface seeped into the base material and the soil volume traversed by the interflow was greatly reduced. Amounts of chemicals carried to the outflow face would also be reduced. There were several situations of base leakage rates, soil conductivities and thickness considered. For leakage rates of practical interest, the source areas and the soil volume traversed by the interflow could be predicted adequately by a simple procedure. The total rates of water interflow in both the nonleaky- and leaky-base cases could be predicted adequately from known reference values of a nonlayered soil by using a weighted average hydraulic conductivity of the layered profile. For prediction of chemicals transported with interflow, knowledge of the flow directions and rate variation along the slope length will be required. (Baker-IVI)
W84-02208

VERIFYING THE EFFECT OF ACID PRECIPITATION ON SOIL LEACHATES: A COMPARISON BETWEEN PUBLISHED RECORDS AND MODEL PREDICTIONS,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
For primary bibliographic entry see Field 5B.
W84-02238

MODELLING THE EFFECTS OF ACID PRECIPITATION ON SOIL LEACHATES: A SIMPLE APPROACH,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
For primary bibliographic entry see Field 5B.
W84-02239

HYDRODYNAMIC DISPERSION DURING ADSORPTION OF WATER BY SOIL; I. MODEL SOIL-MOISTURE PROFILES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. E. Elrick, M. J. L. Robin, and K. B. Laryea.
Journal of Hydrology, Vol. 65, No. 4, p 313-331, September, 1983. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Soil moisture, *Hydrodynamics, *Adsorption, *Dispersion, Soil properties, Model studies, Mixing.

Solute mixing during sorption of water is analyzed for three model soil-water profiles: a step-function profile, an error function complement profile and a curvilinear profile. The solution to the step-function profile showed that the plane about which salt dispersion occurs is coincident with the plane of separation which assumes that all of the water initially present is pushed ahead by the infiltrating water. For the two other model profiles, similar results were obtained using numerical analysis. A simplified approach for calculating these planes, based on the delta-function model is presented for both horizontal and vertical infiltration. The solute balance is maintained for all values of the dispersion coefficient for the flux-related boundary condition only. (Baker-IVI)
W84-02453

HYDRODYNAMIC DISPERSION DURING ABSORPTION OF WATER BY SOIL; 2. IMMOBILE WATER MODEL,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
M. J. L. Robin, K. B. Laryea, and D. E. Elrick.
Journal of Hydrology, Vol. 65, No. 4, p 333-348, September, 1983. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Absorption, *Soil water, *Model studies, *Dispersion, Diffusion, Soil profiles, Hydrodynamics, Immobile water.

The effect of an immobile-water fraction on the dispersion coefficient for a model soil moisture profile is described. If the immobile-water fraction is not accounted for in the formulation, the calculated dispersion coefficient may be higher than the diffusion coefficient of the solute in soil. The advantage of using the model soil profiles in analyses is that they cover the range of possible soil water behavior. Also the effect of immobile water can be examined without any interference from the effects of other phenomena such as anion exclusion, and from experimental problems. Three model soil-water profiles were used in this study having different immobile-water contents up to 0.08 cu m/cu m. Increasing the immobile water content decreased and shifted the average concentration profiles further into the soil. The values of the dispersion coefficient calculated with the immobile water fraction ignored were found to be water content dependent and many times greater than that of the input dispersion coefficient. (Baker-IVI)
W84-02454

2H. Lakes

ROLE FOR SEDIMENTS IN RETARDING THE ACIDIFICATION OF HEADWATER LAKES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and J. R. M. Kelso.
Water, Air, and Soil Pollution, Vol. 20, No. 4, p 379-389, November 1983. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Acidification, *Headwater lakes, *Sediments, *Buffering, Lakes, Hydrogen ion concentration, Calcium, Magnesium, Ontario.

In order to assess the major effects of acidification on sediments, hydrochloric acid was added to aqueous sediment and mineral slurries, and the samples were shaken for a few days. After centrifugation the supernatants were analyzed for Ca, Mg, Al, Fe, Na, K, and pH. Major acid neutralization reactions above pH 4.5 were reactions releasing $Ca(2+)$ and $Mg(2+)$ from the sediments. Analysis of the sediments and water from 97 headwater lakes in northern Ontario showed a predictable decrease in the exchangeable $Ca(2+) + Mg(2+)$ of the sediments with decreasing lakewater pH. Estimates of the total potential buffering capacity for the sediments above PH 4.5 and for water in these headwater lakes were made, and it was found that, even when only the top 1 cm of sediment is considered, a substantial sediment buffering reserve is available. (Moore-IVI)
W84-02137

SOME ASPECTS OF THE UNDERWATER LIGHT CLIMATE OF A REGULATED RIVER,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
W. Kopf.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 168-172, 1983. 7 Fig, 9 Ref.

Descriptors: *Solar radiation, *Photosynthetically active radiation, Water surface, Regulated rivers, Phytoplankton, Suspended solids, Chlorophyll-a.

The loss of PAR (Photosynthetically Active Radiation) due to reflection at the surface of a regulated river averages 10% when measured with an area sensor with cosine response and 25% using a 4-pi spherical quantum sensor. During the vegetation period the monthly average of PAR ranges from 20-35 E/sq m/d when measured with the 4-pi spherical quantum sensor under the water's surface. The role played by diffused underlight is important for the PAR used by photoplankton. This is in accordance with the vertical profile of the spherical quantum sensor as compared to the cosine-area sensor. Suspended matter and phytoplankton (expressed as chlorophyll-a) have a substantial influence on the transmission of PAR in water. The extinction-coefficient can be dissected into a suspended matter portion and a chlorophyll-a-dependent portion using a multiple linear regression analysis. The extinction-coefficient Es (spherical sensor) is significantly correlated to the dry-weight of suspended matter and the concentration of active chlorophyll-a. (Author's abstract)
W84-02141

SENSITIVITY OF PHYTOPLANKTON SIMULATIONS TO VARIATIONS IN THE HALF SATURATION CONSTANTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French.
Water Resources Bulletin, Vol. 19, No. 5, p 729-733, October, 1983. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Phytoplankton, *Simulation, *Michaelis-Menten constant, *Reservoir restoration, Water quality, Chlorophyta, Cyanophyta, Phosphorus, Limiting nutrients.

In many impoundment dynamic water quality models, the growth of two or more ecologic groups of phytoplankton may be simulated. These ecologic groups are differentiated by growth rates, temperature tolerances, settling rates, and the Michaelis-Menten half saturation constants for necessary nutrients. The effect of misestimating the Michaelis-Menten half saturation constant (K) for the limiting nutrient (phosphorus) when two competing ecological groups of algae (blue-green and green) are simulated is examined. In an idealized case, uncertainty in the half saturation coefficient for the limiting nutrient for one ecological group of algae can significantly affect the simuation results and in some cases could lead to a poorly designed impoundment restoration program. For the conditions chosen in this example, the relative magnitude of K (phosphorus) for bluegreen or green algae determined which species of algae was dominant. If K for bluegreen algae is less than K for green algae, then the restoration will not achieve its goal. (Moore-IVI)
W84-02160

LIMNOLOGY OF LAKE WABUKAYNE, A STORM-WATER IMPOUNDMENT,
Environmental Council of Alberta, Edmonton.
B. M. Free, and G. G. Mulamoottil.
Water Resources Bulletin, Vol. 19, No. 5, p 821-827, October, 1983. 4 Fig, 4 Tab, 20 Ref.

Descriptors: *Detention reservoirs, *Stormwater, *Eutrophication, Nutrients, Photosynthesis, Phytoplankton, Dissolved oxygen, Construction, Turbidity, Salt, Chlorides, Meromixis, Invertebrates, Seasonal variation.

The limnology of a 1.9-ha storm-water detention pond is described. The eutrophic nature of this impoundment is attributed to the nutrients in runoff from the surrounding residential area. During the summer, photosynthetic activity of the phytoplankton caused surface waters to become super-saturated with oxygen, while decomposing organic material greatly reduced dissolved oxygen concentrations in the deeper water. Sediment derived from construction activity within the drainage basin caused the impoundment to be turbid. The use of road deicing salts within the drainage basin produced high chloride concentrations and a temporary meromixis during the winter and early spring. The benthic fauna consisted primarily of oligochaetes, chironomids, and chaoborids. High densities of oligochaetes were present in the settling basin. Chaoborid larvae were abundant in the deep basin where low oxygen concentrations reduced the numbers of other benthic macroinvertebrates. (Author's abstract)
W84-02172

AGGREGATION OF VARIABLES IN SIMULATION MODELS OF WATER ECOSYSTEMS,
N. K. Luckyanov, Yu. M. Svirezhev, and O. V. Voronkova.
Ecological Modelling, Vol. 18, No. 3/4, p 235-240, April, 1983.

Descriptors: *Simulation, *Mathematical models, *Ecosystems, Variable aggregation, Aquatic life, Theory, Model studies.

One of the most difficult problems of ecological systems modelling is that of dimension. Even such a comparatively simple object as an oligotrophic waterbody has more than 80 types of zooplankton, 350 types of benthos, about 50 types of fish, etc. To decrease model dimensions, it is necessary to make variable aggregation, to unite some variables of the system that are related to one another into some sort of blocks each of which is a new variable with the properties defined by the aggregation laws. Usually one accepts the hypothesis that the aggregated variables are simple sums of the constituent variables, and one considers that the law of the aggregated variables' interaction is the same as the law for the nonaggregated interaction, but this is not true. The model often loses its property of parametrical universality. Two theorems are developed which give one an opportunity to obtain some criteria of aggregation for models of water ecosystems that are described by a system of differential equations. Founded on the theory of variable aggregation, the idea was formulated that it was reasonable to take piecewise linear functions as trophical functions for water ecosystems. (Moore-IVI)
W84-02235

STRUCTURE AND FUNCTION OF A WARM MONOMICTIC LAKE,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
K. C. Ewel, and T. D. Fontaine, III.
Ecological Modelling, Vol. 19, No. 2, p 139-161, June, 1983. 14 Fig, 3 Tab, 52 Ref.

Descriptors: *Monomictic lakes, *Ecosystems, *Simulation, Biomass, Aquatic plants, Nutrient cycling, Phytoplankton, Zooplankton, Food chains, Model studies, Lake Conway, Florida.

Construction and simulation of a model of Lake Conway, Florida, U.S.A., provided a framework for defining major characteristics of this ecosystem. The relationships that are formalized in this model comprise a set of hypothesis about the nature of a warm monomictic lake. The data that were used to parameterize the model came primarily from literature estimates, although approximations of biomass levels were available from associated research conducted on the lake. Submersed macrophytes are a major biomass component in Lake Conway; simulation suggested that their role in nutrient recycling overshadows their importance in the grazing food chain. Phytoplankton biomass and degree of fluctuation are considerably lower than are observed in most cool temperature lakes, although simulated respiration and herbivory rates are closer to temperate values than tropical values. Simulated epipelic algae biomass varies an order of magnitude during the year, and this group appears to be a significant part of the food chain. Simulated zooplankton consumption and turnover rates are very high, in part because of the relatively small biomass per individual. Simulation of the model suggests that slightly more carbon is processed through the grazing food chain in Lake Conway than through the detritus food chain. (Author's abstract)
W84-02237

TEST OF TWO MODELS OF DIFFERENT LEVELS OF COMPLEXITY FOR PREDICTING CHANGES OF PHOSPHORUS CONCENTRATION IN A LAKE'S OUTFLOW,
McMaster Univ., Hamilton, Ontario. Dept. of Civil Engineering.
W. J. Snodgrass, and P. J. Dillon.
Ecological Modelling, Vol. 19, No. 3, p 163-187, July, 1983. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphorus, *Mathematical models, *Outflow, Hydraulic loading, Temporal distribution, Stratification, Lakes, Canada.

The objective of this investigation is to compare the ability of a one-box model and a two-box model to predict the temporal variations of total phosphorus in the outflow of several lakes. The one-box model considers only total phosphorus and treats the lake as well-mixed, all year round. The two-box model considers two phosphorus fractions and the epilimnion and hypolimnion. For five shallow Canadian Shield lakes, some of the temporal variability in lake phosphorus concentrations can be explained on the basis of changes in hydraulic inflows and phosphorus loadings. Both models give roughly similar predictions for shallow lakes with high hydraulic loadings (1-200 m/year) and small variations in total phosphorus concentrations. In comparing the settling and hydraulic outflow mechanisms, a sensitivity analysis shows that both models are more sensitive to the settling rate if the lake's hydraulic loadings are less than 1 m/year, and more sensitive to the outflow rate if the lake's hydraulic loadings are greater than 100 m/year. This analysis suggests a priority for concentrating economic and other resources in conducting field measurement programs for testing phosphorus models. (Author's abstract)
W84-02240

SUSPENSOID CHARACTERISTICS IN SUBALPINE CASTLE LAKE, CALIFORNIA; II. OPTICAL PROPERTIES,
DSIR, Taupo (New Zealand). Div. of Marine and Freshwater Science.
J. C. Priscu.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 425-433, August, 1983. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Suspensoids, *Light extinction, *Castle Lake, *California, *Optical properties, Chlorophyll, Particulate matter, Dissolved solids, Plankton, Photosynthesis, Hypolimnion, Epilimnion, Cirque lakes, Solar radiation.

The epilimnetic and hypolimnetic waters in Castle Lake, a small meso-oligotrophic cirque lake in northern California, were analysed with respect to their properties of light extinction. The vertical extinction of downwelling photosynthetically available radiation (PAR) was partitioned into that caused by chlorophyll, non-chlorophyllous particulate matter, dissolved substances, and that due to the water alone through a modification of the Beer-Lambert model. Over 65% of the total light extinction was caused by nonchlorophyllous suspensoids in both epilimnetic and hypolimnetic waters. The relative extinction of light by chlorophyll was approximately 10 and 20% for epilimnetic and hypolimnetic water layers, respectively, and delineates the deep-phytoplankton maximum that exists in Castle Lake. Dissolved substances accounted for less than 2% of the PAR at the depths studied; the remaining extinction was caused by the water alone. The large background extinction in Castle Lake may act to restrict integral rates of photosynthesis to less than 20% of the potential upper limit. (Author's abstract)
W84-02244

LIGHT CONDITIONS IN LAKE ZURICH, 1980/81; PART II: SURFACE EFFECTS,
Hydrobiologische-limnologische Station, Kilchburg (Switzerland).
F. Schanz.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 501-508, August, 1983. 3 Fig, 16 Ref.

Descriptors: *Solar radiation, *Surface effects, *Lake Zurich, Back radiation, Light penetration, Wave action, Back radiation, Clouds.

Weekly measurements of light intensity above and below the surface of the Lake Zurich were carried out during the period 1980/81 in order to study the short-wave back radiation (400-700 nm), and the fraction of incident light which penetrates into the water. Back radiation on cloudy days remains more or less constant at 5.4% of incident light. On non-cloudy days back radiation decreases with increasing incident light intensity, mainly as a result of the decrease in reflected light with increasing solar declination. A linear relationship between solar declination and albedo (back radiation as a percentage of incident radiation) was found in the range 20 to 56 degrees of sun elevation. From April to September, as a result of the approximately constant solar declination, the albedo is determined in the main by the amount of suspended material in the upper 5 m. The relationship between the light intensity measured above the surface and that measured below the surface was found to be linear from 0.05 to 1.00 mE/sq m/s and also from 1.01 to 2.10 mE/sq m/s. The mean energy loss at the surface based on all available data amounted to 7%. Wave action reduces losses in light energy at the surface on cloudy days. On overcast days it can be assumed that the light data measured with either a smooth or rough lake surface belong to the same population. This allows a determination of the influence of waves on surface loss: 16% was calculated for a smooth surface and 11% for a rough surface. (Moore-IVI)
W84-02245

FISHERIES SITUATION IN THE PERUVIAN AMAZON REGION (ZUR SITUATION DER FISCHEREI IM PERUANISCHEN AMAZONASGEBIET),
Konstanz Univ. (Germany, D.R.). Limnologische Inst.
V. R. Eckmann.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 509-539, August, 1983. 6 Fig, 6 Tab, 32 Ref.

Descriptors: *Fisheries, *Amazon Region, *Loreto, *Peru, Fish, Water level fluctuations, Fish management, Fish farming, Aquaculture.

The fisheries in the Peruvian Department of Loreto are characterized according to the fish fauna, fishing methods, preservation and transport techniques. Only 30 out of the approximately 2000 Amazonian fish species are suitable for human consumption. Method of preservation, transport, and storage still need improvement and therefore mass catches cannot be sold completely. Recent qualitative changes in the fish supply of the capital of Loreto, Iquitos, can be attributed to an intensive exploitation of fish stocks. Microphagous species are prevalent in the supply for the urban centers while in rural areas herbivorous and carnivorous species predominate. The extreme fluctuations in catches of the most important microphagous characin, Prochilodus cf. nigricans, are dependent on water level fluctuations. It is impossible to register completely the fish yields in this region; totals are estimated at 34,000 tons for 1980. By including new species, intensifying the fishing of siluroid species and by exploiting microphagous species in remote regions, total fish yields could be increased. Aquaculture could help to improve the supply of fish protein for the larger cities as well as for the rural population. Fish farms in the transition zone between the lowlands and the Andes could help to diminish fish exports from the Amazon region to into this zone. (Moore-IVI)
W84-02246

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES; VII BUSHMANS, KARIEGA, KOWIE AND GREAT FISH RIVERS,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W84-02306

TRANSPORT OF MATTER AND ENERGY IN A STRATIFIED EUTROPHIC LAKE AND ITS CHANGE UNDER AN EXTERNAL EFFECT,
V. F. Brekhovskikh, and I. A. Korneev.
Water Resources, Vol. 9, No. 4, p 356-363, July-August, 1982. 3 Fig, 2 Tab, 13 Ref. Translated from Vodnye Resursy, No. 4, p 27-35, July-August, 1982.

Descriptors: *Eutrophication, *Lakes, *Sediment transport, *Energy, Thermoclines, Temperature effects, Stratification, Dissolved oxygen, Diffusion, Lake Medvezh'e, USSR.

An attempt was made to determine, by calculation, the coefficients of diffusivity and diffusion of dissolved oxygen in the thermocline and hypolimnion of a stratified eutrophic lake in which summer artificial aeration was carried out. The investigations were conducted on Lake Medvezh'e outside Moscow (USSR) with a water volume of 315,000 cu m, surface area of 11 ha, and maximum depth of 8.6 m. The lake is surrounded by forests and has the shape of an almost regular circle. The data obtained allow the conclusion that the values of the coefficients of diffusivity and diffusion are close to molecular during the stagnation period in the thermocline of the lake. A noticeable eddy component appears in the lower part of the thermocline, which becomes dominant in the hypolimnion. During artificial aeration that thermocline is eroded, heat and mass exchange between the epilimnion and hypolimnion increased, but the values of the coefficients of the diffusivity and diffusion of oxygen indicate that before homothermy is reached the transport of heat and matter in the hypolimnion, as usual, is determined mainly by vertical turbulence. (Baker-IVI)
W84-02351

ENRICHED C-13 COMPOSITION OF INTERSTITIAL WATERS IN SEDIMENTS OF A FRESHWATER LAKE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. V. Turner, and P. Fritz.
Canadian Journal of Earth Science, Vol. 20, No. 4, p 616-621, April, 1983. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Interstitial water, *Lake sediments, *Carbon radioisotopes, Bacteria, Sediments, Lakes, Methanogenesis, Ontario, Little Lake, Carbonates, Carbon dioxide, Hydrogen ion concentration.

The dissolved inorganic carbon of interstitial waters from sediments of a small carbonate-precipitating lake in southern Ontario has highly enriched C-13 values. This post-depositional isotopic enrichment is attributed to the metabolism of methanogenic bacteria. As methanogenic bacteria produce metabolic carbon dioxide, the pCO2 of the interstitial waters increases and pH decreases. The H(+) generated is buffered by carbonate dissolution, leading to the observed increase in Ca and carbonate alkalinity with depth. A decline in bacterial activity, possibly during winter months, would be accompanied by a decrease in pCO2 and increasing pH. Subsequent supersaturation of the interstitial waters with respect to calcite could lead to precipitation and incorporation of dissolved inorganic carbon enriched in C-13 in the marl. Data which show the interstitial waters at or very close to saturation with respect to calcite at high pCO2 are consistent with this theory. Such freshwater carbonate sediments with interstitial waters enriched in C-13 provide a unique environment for study of isotope relations during carbonate diagenesis under accessible conditions and with a time scale of geologic relevance. (Baker-IVI)
W84-02365

TROPHIC RESOURCE ALLOCATION BETWEEN PERCINA SCIERA AND P. OUACHITAE IN THE TOMBIGBEE RIVER, MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
G. L. Miller.
American Midland Naturalist, Vol. 110, No. 2, p 299-313, October, 1983. 7 Tab, 59 Ref.

Descriptors: *Aquatic habitats, *Species composition, Trophic level, Rivers, Morphology, Tombigbee River, Mississippi, Species diversity, Darters, Aquatic habitats.

Aspects of trophic ecology of Percina sciera and P. ouachitae from a site on the Tombigbee River, Mississippi, were compared to determine the extent of seasonal, sexual and size class trophic allocation in the two species; describe the feeding habitats of the two species and compare these habitats to a syntopic group of benthic fishes, and determine whether a relationship exists between predator morphology and prey characteristics. The two species had similar diets which corresponded closely to diets for darters of similar habitats. There were small qualitative differences in diet, and gut content changed seasonally in both species. Percina sciera took larger prey than P. ouachitae in the autumn, and this was related to differences in fish size (standard length). Males and females differed in prey size selectivity and the differences were greatest in the spring. With the exception of standard length, no morphological trait of the two species was highly correlated with prey size. Trophic competition is likely of minor importance between these species. (Author's abstract)
W84-02375

SURVIVORSHIP AND PARASITE-INDUCED HOST MORTALITY AMONG MOSQUITOFISH IN A PREDATOR-FREE, NORTH CAROLINA COOLING RESERVOIR,
Wake Forest Univ., Winston-Salem, NC. Dept. of Biology.
W. O. Granath, Jr., and G. W. Esch.
American Midland Naturalist, Vol. 110, No. 2, p 314-323, October, 1983. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Population dynamics, *Fish, *Reservoirs, Mosquitofish, Aquatic habitats, Mortality, Parasites, Population dynamics, Water temperature, Predation.

Survivorship of mosquitofish infected with the pseudophyllidean tapeworm Bothriocephalus acheilognathi was significantly reduced as compared with uninfected mosquitofish when fish were held at temperatures of 20, 25, and 30 C. Survivorship of infected and uninfected fish was also significantly reduced as water temperatures were increased to 25 and 30 C. When mosquitofish were maintained at 25 C, larger individuals with lower parasite densities survive longer than smaller individuals with higher densities of the cestode. Pearson correlation and multiple regression analyses of survival time of Gambusia affinis on density of Bothriocephalus acheilognathi and total host length indicate that survivorship is a function of parasite density and host size. Certain demographic characteristics of mosquitofish populations in a system devoid of piscivorous predators (but with B. acheilognathi) were compared with those in a system having piscivorous predators (but without B. acheilognathi). Random samples of mosquitofish taken monthly from the two systems revealed no significant differences in either sex ratios or in mean lengths of male or female mosquitofish. The Krumholz (Int. Rev. Gesamten Hydrobiol., 48:201-256. 1963) predation hypothesis would predict otherwise, to wit, that sex ratios in the predator-free system should be 1:1 (with predators, sex ratios should be approximately 1 male: 2 females) and that both males and females should be significantly larger than males and females in a system possessing a full complement of piscivorous fishes. It is hypothesized that similarities among demographic features of mosquitofish populations in the two systems investigated in the present study are the result of parasite-induced, size-selective host mortality in the predator-free system on the one hand and of predation pressure from piscivorous fishes on the other. (Author's abstract)
W84-02376

EFFECTS OF SUSPENDED SILT ON FEEDING AND REPRODUCTION OF DAPHNIA PULEX,
Kansas Univ., Lawrence. Dept. of Systematics and Ecology.
C. D. McCabe, and W. J. O'Brien.
American Midland Naturalist, Vol. 110, No. 2, p 324-337, October, 1983. 8 Fig, 39 Ref.

Descriptors: *Zooplankton, *Suspended sediments, *Silt, *Feeding, *Reproduction, *Daphnia, Turbidity, Lakes, Clay, Aquatic habitats, Population dynamics.

The effects of suspended silt on the feeding and reproduction of Daphnia pulex and the impact of suspended silt and clay on freshwater zooplankton community structure were investigated. The effects of suspended silt and clay on the filtering and assimilation rates of Daphnia pulex were determined using a C-14 radiotracer method. Both filtering and assimilation rates are severely depressed at even low concentrations of suspended silt and clay. Life table studies also showed population growth rate of zooplankton was significantly diminished by suspended silts and clays. The relative abundance of zooplankton varied markedly between two lakes of differing turbidity levels, the more turbid lake having a higher relative abundance of large zooplankton species. Suspended silt and clay reduced zooplankton feeding and production. Zooplankton production was reduced by as much as 16 times that possible in nonturbid water. These effects, combined with the fact that high levels of suspended silts and clays reduce the photic zone and thus the potential primary productivity, also reduced the ability of planktivorous fish to find their prey. Thus turbidity may greatly reduce the trophic efficiency and productivity of affected lakes and reservoirs. (Baker-IVI)
W84-02377

LIFE HISTORY AND DISTRIBUTION OF THE ROANOKE BASS AMBLOPLITES CAVIFRONS COPE, IN VIRGINIA,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
H. J. Petrimoulx.
American Midland Naturalist, Vol. 110, No. 2, p 338-353, October, 1983. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Fish, *Population dynamics, Bass, Environmental effects, Drainage basins, Seasonal variations, Virginia, Roanoke, Chowan.

The life history and Virginia distribution of the Roanoke bass Ambloplites cavifrons Cope was studied from January 1979 through January 1980. Populations in the Roanoke and Chowan drainages were disjunct and locally uncommon, possibly owing to the patchiness of suitable physical habitat. Growth of male and female Roanoke bass was similar and significantly greater when compared with northern rock bass Ambloplites rupestris and redbreast sunfish Lepomix auritus. Ponderal indices were similar for both sexes and age dependent. Young A. cavifrons consumed small aquatic invertebrates; juveniles included crayfish and fish in the diet; adults ate predominantly crayfish. Seasonal diet variation was greater among juveniles than adults. Maturity occurred at age II if 150 mm TL and 75 g body weight had been attained. The reproductive season extended from May through June as water temperatures approached 20 C. Fecundity estimates exhibited a linear relationship to length and weight. Evidence of widespread year-class failure in 1978 and 1979 was attributed to adverse spring stream conditions. Ecological and environmental impacts have caused a recent decline in Roanoke bass abundance, warranting the species the conservation status of Special Concern. (Author's abstract)
W84-02378

INVESTIGATIONS ON ZOOPLANKTON AND ZOOBENTHOS IN THE LITTORAL OF A NEWLY BUILT RESERVOIR (ZOOPLANKTON- UND ZOOBENTHOSUNTERSUCHUNGEN IM LITORAL EINER NEUENTSTANDENEN TALSPERRE (TWISTETALSPERRE, NORDHESSEN)),
Kassel Univer. (Germany, F.R.). Inst. fur Zoologie/Limnologie.
W. Meinel, U. Matthias, and B. Schade.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 145-162, June, 1983. 8 Fig, 3 Tab, 23 Ref.

Descriptors: *Reservoirs, *Aquatic life, *Littoral environment, *Zooplankton, *Zoobenthos, Plankton, Twistetalsperre, Hesse, West Germany.

The first settlement of zooplankton and zoobenthos was investigated qualitatively and quantitatively in the littoral of a newly built reservoir (Twistetalsperre, Hesse, Federal Republic of Germany). In front of the main reservoir a preimpoundment basin, which has already been in operation for four years, is situated. Most of the plankton and benthos living in the main reservoir was also found in the preimpoundment basin. However, the settlement of the new reservoir in the first year was less than in the preimpoundment basin concerning the number of species and individuals. (Author's abstract)
W84-02382

NITROGEN METABOLISM IN LAKE KIZAKI, JAPAN; IV. AMMONIUM MAXIMUM LAYER IN THE METALIMNION,
Nagoya Univ. (Japan). Water Research Inst.
M. Takahashi, and Y. Saijo.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 180-195, June, 1983. 6 Fig, 19 Ref.

Descriptors: *Nitrogen, *Metabolism, *Limnology, Lake, *Kizaki, *Japan, *Ammonium, Metalimnion, Thermocline, Thermal stratification, Nitrification, Mathematical models, Phytoplankton.

In Lake Kizaki, the ammonium maximum layer was observed in the metalimnion during July to October in 1977. This layer was observed in the depth just below the trophogenic layer. The thickness of this layer was about 3 m, and the highest concentration was 13.9 microgram atom/liter. In order to explain the mechanism of the development and maintenance of the ammonium maximum layer, a simple numerical two-dimensional model with biological and physical parameters obtained in the previous study in this series is used to simulate the vertical distributions of ammonium in the metalimnion. At the depth where the maximum layer developed, the production of ammonium was superior to its consumption. This depth was in the stable thermocline. The physical transport of ammonium by eddy diffusivity was minimal. Therefore, the major part of ammonium produced was accumulated in this depth. Above this layer phytoplankton assimilation of ammonium exceeded the production of ammonium. Below this layer the consumption of ammonium through the nitrification process exceeded its production. (Baker-IVI)
W84-02383

QUANTITATIVE STUDIES ON CHIRONOMIDAE AND OLIGOCHAETA IN THE BENTHOS OF LAKE BALATON,
Hungarian Academy of Sciences, Tihany. Biological Research Inst.
J. E. Ponyi, I. Tatrai, and A. Franko.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 196-207, June, 1983. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Benthos, *Lakes, *Midges, *Oligochaetes, *Lake Balaton, Hungary, Annual distribution, Eutrophic lakes, Mesotrophic lakes, Biomass.

The biomass of Chironomidae larvae and Oligochaeta, its changes during various years and distribution in Lake Balaton (Hungary) are described. The biomass of the larvae of chironomids was about 5 to 8 times higher in the eutrophic basin than in the mesotrophic one (monthly means 1.2-4.2 and 0.25-0.49 g/sq m in dry weight, respectively). The 2 to 3 maxima of chronomid biomass, observed in Lake Balaton, seems to be typical for shallow eutrophic lakes. The biomass of chironomid has increased in the eutrophic part of the lake by three times between 1960-76, however it did not change in the other parts of Lake Balaton. The biomass of oligochaetes was the highest immediately beside the edge of the reed belt (3.7 g/sq m dry weight) and lowest (1.7 g/sq m) in the central part of the lake. The biomass of oligochaetes surpassed in the eutrophic basin that of the mesotrophic one only by 1.4 times. (Author's abstract)
W84-02384

TUBIFICIDAE OF THE LITTORAL OF LAKE CONSTANCE, REGARDING ESPECIALLY POTAMOTHRIX MOLDAVIENSIS (DIE LITORALEN TUBIFICIDAE DES BODENSEES MIT BESONDERER BERUCKSICHTIGUNG VON POTAMOTHRIX MOLDAVIENSIS),
P. Frenzel.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 262-280, June, 1983. 6 Fig, 2 Tab, 51 Ref.

Descriptors: *Tubificids, *Distribution, *Reproduction, *Water pollution effects, Eutrophication, Lumbriculids, Lake Constance, Water temperature, Depth.

Parallel with man-made eutrophication the community of Tubificidae and Lumbriculidae in the littoral of the western part of Lake Constance has changed. Immigration of species has not taken place. Depth distribution, interspecific affinities, and time of reproduction of most species are described. In 1977/1978, eleven species of Tubificidae could be found in the vicinity of Insel Mainau in the western part of Lake Constance. According to their depth distribution Tubifex tubifex, T. ignotus, Potamothrix moldaviensis and P. hammoniensis show a preference for the littoral, and Peloscolex ferox and Psammoryctides barbatus for the littoriprofundal; in Limnodrilus hoffmiesteri no clear trend could be found. The fauna in 1977/1978 is very different from that found in the same area in 1936/1937, with changes in frequency, the disappearance of some species, and the spread of some species present in locally polluted area in 1937. One possible explanation for the annual pattern of reproduction for Potamothrix moldaviensis is that the birth rate is not as strongly retarded by low temperture as the hatching rate is. This will lead to an accumulation of the progeny in the egg-phase during winter and to a synchronization of the population by means of the annual temperature regime. (Moore-IVI)
W84-02386

INFLUENCE OF WATER LEVEL, HUNTING PRESSURE AND HABITAT TYPE ON CROCODILE ABUNDANCE IN THE FLY RIVER DRAINAGE, PAPUA NEW GUINEA,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. J. Montague.
Biological Conservation, Vol. 26, No. 4, p 309-339, 1983. 7 Fig, 9 Tab, 41 Ref.

Descriptors: *Crocodiles, *Papua New Guinea, *Water level, *Hunting, Juvenile growth stage, Behavior, Swamps, Flooding, Strickland River, Burnett River.

Between October 1978 and July 1980, day and night crocodile surveys were conducted at low, normal and high water levels over 2703 km of river and lakeshore in the Western and Southern Highlands provinces of Papua New Guinea. The 1353 crocodiles seen ranged between 0.18 and 2.23 animals per km. Night counts recorded 12.9 times as many crocodiles as day counts over the same area. This may indicate more nocturnal activity than occurs in other crocodilians. Unhunted areas had a greater proportion of large crocodiles than did hunted regions. As the water level rose, the 'visible juveniles' category decreased as a result of migration into newly flooded adjacent swamplands. The upstream range of New Guinea crocodiles on the Strickland River extended only to the Burnett River junction. There was an increase in flight distance (wariness) with increasing body size and this rate of increase was over twice as large for hunted populations as for unhunted ones. (Author's abstract)
W84-02387

PHOTOSYNTHETIC INORGANIC CARBON USE BY FRESHWATER PLANTS,
The University, St. Andrews (Scotland). Dept. of Botany.
S. C. Maberly, and D. H. N. Spence.
Journal of Ecology, Vol. 71, No. 3, p 705-724, November, 1983. 9 Fig, 1 Tab, 58 Ref.

Descriptors: *Aquatic plants, *Phytoplankton, *Carbon dioxide, *Bicarbonate, Seasonal variation, Inorganic carbon, Alkalinity, Photosynthesis, Lakes.

A pH-drift technique was used to calculate free CO2 (CO2*) and bicarbonate, HCO3(-), compensation points for a range of freshwater macrophytes and phytoplankters. Some half-saturation constants for CO2 uptake were also estimated. The validity

of the technique and interpretation is generally confirmed. Variation in the CO2* compensation point of Hippuris vulgaris was related to the oxygen concentration of the bathing medium, and seasonal changes in HCO3(-) compensation point were found in Potamogeton filiformis and in HCO3(-) and CO2* compensation points in Elodea canadensis. The performance of these two macrophytes is probably affected more by seaonal changes in HCO3(-) compensation points than by CO2* compensation points. The quotient of total carbon remaining at the end of a pH-drift experiment to the constant alkalinity of the solution (Ct/Alk) was used as a measure of the uptake ability of a species. Ranked by this criterion, species showed a fairly continuous range in uptake ability with a nearly fifteen-fold difference between the most efficient (low quotient) and least effluent (high quotient) species. Although the uptake abilities of macrophytes and phytoplankters overlapped, the four most efficient carbon extractors were phytoplankters, and the nine least efficient were macrophytes. Anabaena cylindrica, Microcystis aeruginosa and Scendesmus quadricauda removed more than 90% of the available carbon compared with 70% for the most efficient macrophytes tested (Myriophyllum spicatum and Potamogeton perfoliatus). Those species which remove 5% or less of the available carbon are taken to be unable or poorly able to use HCO3(-). Such macrophytes may benefit from: growing in unproductive lakes that do not experience carbon depletion; seasonal access to aerial CO2; high CO2* concentrations in and close to the sediment. Competition for inorganic carbon may be an important factor determining the outcome of seasonal and longer-term changes in the species composition of productive freshwaters. The reduction or loss of submerged macrophytes in certain recently enriched lakes may result partly from carbon competition with phytoplankton. (Author's abstract)
W84-02399

SEDIMENTOLOGY AND GEOCHEMISTRY OF RECENT SEDIMENTS OFF THE MOUTH OF THE NIAGARA RIVER, LAKE ONTARIO,
Canada Centre for Inland Waters, Burlington, Ontario.
P. G. Sly.
Journal of Great Lakes Research, Vol. 9, No. 2, p 134-159, 1983. 19 Fig, 6 Tab, 39 Ref.

Descriptors: *Lake Ontario, *Niagara River, *Lake sediments, Geochemistry, Bathimetry, Trace elements, Particle size, Niagara Bar, Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Dispersal patterns, Suspended load.

Sediment thickness and bathymetric characteristics were derived from echo sounding, side scan sonar, and shallow seismic reflection recordings. Sediment samples were analyzed for particle size, major and trace elements, and for benthic organisms. The Niagara Bar has been separated into Inner and Outer Bar deposits and it is proposed that the Outer Bar was formed during an earlier, lower stage of Lake Ontario. Both deposits appear to be largely derived from reworked, local, shoreline materials. Trace element analyses indicate that the surficial sediments (prior to the 1972 Great Lakes Water Quality Agreement) were moderately enriched in Cd, Cr, Cu, Pb, and Zn, and greatly enriched in Hg. Normalized distributions of trace elements in the bar sediments show the presence of distinct dispersal patterns. These dispersals indicate that some of the suspended load passes out of the main outflow channel, across the bar, and toward west and north northwest directions. Particle-size and geochemical characteristics of the off-shore sediments indicate that they differ significantly from marginal facies and imply that local variations in the forms and type of peripheral inputs to the lake have little influence on deep basin deposits. (Author's abstract)
W84-02405

NEPHELOID LAYER IN LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Aquatic Ecology Div.
R. G. Sandilands, and A. Mudroch.
Journal of Great Lakes Research, Vol. 9, No. 2, p 190-200, 1983. 13 Fig, 5 Tab, 21 Ref.

Descriptors: *Lake Ontario, *Nepheloid layer, *Transmissivity, Turbidity, Suspended sediments, Diatoms, Quartz, Calcite, Clay, Particulate matter, Soluble reactive phosphorus, Reactive silica, Lead, Zinc.

A study was designed to investigate the existence and extent of a nepheloid layer in Lake Ontario. A transmissometer profile of the entire water column was obtained monthly from 94 stations in Lake Ontario during the period of August to December, 1981. The profiles indicated that a turbid layer at the lake bottom existed over the entire lake at water depths greater than 60 m. The thickness of the layer averaged 22 m in August and September, but doubled to 45 m in October. In addition, the average transmission was lowered from 60% in August and September to 45% in October. A significant increase in soluble reactive phosphorus (SRP) and reactive silica (RSiO2) in the nepheloid layer was observed. Quartz and calcite were the major mineral constituents of the suspended matter present in the layer. The particles in the nepheloid layer in the western basin of Lake Ontario consisted of many diatoms and some calcite particles and clay minerals. In the central and eastern basins the number of calcite particles significantly increased. Concentrations of Pb and Zn in the suspended matter sampled from the nepheloid layer at the Niagara River mouth were similar to those found in the 1-cm surface sediment at the same station (124 micro g/g Pb, 318 micro g/g Zn, and 139 micro g/g Pb and 356 micro g/g Zn, respectively). (Author's abstract)
W84-02409

DOWNFLUX OF SEDIMENT, ORGANIC MATTER, AND PHOSPHORUS IN THE NIAGARA RIVER AREA OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Aquatic Ecology Div.
M. N. Charlton.
Journal of Great Lakes Research, Vol. 9, No. 2, p 201-211, 1983. 11 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake Ontario, *Nepheloid layer, *Niagara River, Sediments, Organic matter, Phosphorus, Water circulation, Suspended sediments, Sedimentation, Downflux.

Vertical arrays of sediment traps were installed near the mouth of the Niagara River and at nearshore and offshore sites. Surveys of temperature, turbidity, and conductivity were used to establish that the traps nearest the river mouth were under the river outflow plume. A single offshore array in 1980 indicated downfluxes of 1-2 g/sq m/d of dry matter in the mid-water column. These fluxes were similar to those of small lakes but much higher fluxes were found near the bottom of Lake Ontario. More extensive work in 1981 confirmed the presence of a near-bottom nepheloid layer and the effect it has on the increasing downflux estimates. Sediment traps near shore and at the river mouth caught substantially more material at all depths than did traps at the offshore stations. Downfluxes of phosphorus and sediment were consistent with independent estimates of loading and retention. (Author's abstract)
W84-02410

STATISTICAL EVALUATION OF TRENDS IN THE WATER QUALITY OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 5B.
W84-02412

NUTRIENT REGENERATION BY ZOOPLANKTON IN SOUTHERN LAKE HURON,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
J. Korstad.
Journal of Great Lakes Research, Vol. 9, No. 3, p 374-388, 1983. 6 Fig, 6 Tab, 55 Ref.

Descriptors: *Zooplankton, *Lake Huron, *Cycling nutrients, Nutrient regeneration, Phosphorus, Ammonia, Nitrates, Nitrites, Silica, Diel distribution, Plankton.

Rates of nutrient regeneration by zooplankton (micro mol/mg dry wt/hr) in southern Lake Huron from April to August 1975 ranged from undetectable to 2.6 for total phosphous (TP), undetectable to 0.8 for total soluble phosphorus (TSP), undetectable to 0.12 for soluble reactive phosphorus (SRP), undetectable to 0.97 for ammonia (NC3) undetectable to 3.8 for nitrate plus nitrite (NO3 + NO2), and undetectable to 2.9 for silica (SiO2). Two diel experiments were conducted. Times of highest rates of regeneration varied for the different nutrients on these dates. Using the average concentration of zooplankton in the surface waters during this study, the calculated average concentration of nutrients regenerated by zooplankton ws 0.012 micro mol P/L/hr for TP, 0.0046 micro mol P/L/hr for TSP, 0.0016 micro mol P/L/hr for SRP, 0.0146 micro mol N/L/hr for NH3, 0.043 micro mol N/L/hr for NO3 + NO2 and 0.058 micro mol Si/L/hr for SiO2. The contribution of nutrient regeneration by zooplankton to the turnover time of the various nutrients in the surface waters was calculated to be 212 hr for TP, 239 hr for TSP, 69 hr for SRP, 62 hr for NH3, 505 hr for NO3 + NO2 and 531 hr for SiO2. Although the turnover time for most of these nutrients is fairly slow, the nutrient pools for SRP and NH3 are replenished in less than 70 hr by nutrient regeneration. Zooplankton therefore appear to play a significant role in the cycling of SRP and NH3 in southern Lake Huron. (Moore-IVI)
W84-02424

ADDITIONS OF NUTRIENTS AND MAJOR IONS BY THE ATMOSPHERE AND TRIBUTARIES TO NEARSHORE WATERS OF NORTHWESTERN LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
B. A. Manny, and R. W. Owens.
Journal of Great Lakes Research, Vol. 9, No. 3, p 403-420, 1983. 16 Fig, 7 Tab, 41 Ref.

Descriptors: *Nutrients, *Lake Huron, *Atmospheric fallout, *Tributaries, Nitrogen, Phosphorus, Ditching, Clear-cutting, Watersheds, Silica, Sodium.

Nutrient additions by the atmosphere and six tributaries to nearshore waters of northwestern Lake Huron were measured at weekly intervals from August 1975 to July 1976. The atmosphere contributed 43% of the nitrogen (N) and 10% of the phosphorus (P) that was added during the year. The 1975-76 atmospheric loading rate of total N to this area (11 kg/ha/yr) was one of the highest found to date in the United States. N was conserved more efficiently than P in the tributary drainage basins. Of the N and P that fell annually on the watersheds under study, 2 to 37% of the N and 31 to 84% of the P was carried with runoff to the lake. From a basin where ditching and clear-cutting occurred, water, P, silica (SiO2), N, and sodium were lost at higher rates than from five other basins. Most of the N in bulk atmospheric samples (23%) and tributary waters (56%) was dissolved organic N, a form of N not often measured. (Author's abstract)
W84-02425

SPRING PH AND ALKALINITY DEPRESSIONS IN LAKE SUPERIOR TRIBUTARIES,
Ontario Ministry of the Environment, Sudbury.
W. Keller.
Journal of Great Lakes Research, Vol. 9, No. 2, p 425-429, 1983. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Alkalinity, *Hydrogen ion concentration, *Seasonal variation, *Ontario, *Tributaries, *Lake Superior, Speckled Trout Creek, Barrett River, Buffering capacity, High flow, Fisheries.

Between October 1980 and October 1981, the pH and alkalinity of 21 Lake Superior tributaries in Ontario were measured. All tributaries, even those with high buffering capacity during most sampling periods, showed substantial reductions in pH and alkalinity during spring runoff. Recorded minima for these parameters were associated with high spring flows while maxima were associated with

low flow periods, primarily in late summer. In most tributaries the degree of pH depression observed was not extreme; however, Speckled Trout Creek and the Barrett River exhibited low minimum pH (5.09 and 5.00, respectively) and an additional five showed pH minima in the range of 5.5 to 6.0. Although adverse effects on fish populations in the study area have not been documented, concern over possible influences is warranted because these waters exhibit generally high sensitivity to acidic inputs and most constitute valuable fishery resources. (Moore-IVI)
W84-02427

CONE-SHAPED HYPOLIMNION AND LOCAL REACTOR AS OUTSTANDING FEATURES IN EUTROPHICATION OF LAKE MARACAIBO,
Estudios y Controles en Contaminacion, Caracas (Venezuela).
For primary bibliographic entry see Field 5C.
W84-02428

ESTIMATING LARVAL FISH ABUNDANCES FROM PLANKTON NET CATCHES IN LONG POINT BAY, LAKE ERIE, IN 1971-78,
Ontario Ministry of Natural Resources, Port Dover.
J. M. Hamley, T. P. Howley, and A. L. Punhani.
Journal of Great Lakes Research , Vol. 9, No. 4, p 452-467, 1983. 6 Fig, 7 Tab, 34 Ref.

Descriptors: *Larval growth stages, *Fish populations, *Long Point Bay, *Lake Erie, Ontario, Nanticoke, Smelt, Cyprinids, Environmental effects, Sampling, Industrial development.

Larval fish were sampled in Long Point Bay (Ontario) each summer in 1971-78 by towing 1/2-m and 1-m diameter plankton nets at about 1 m/s. The analysis of 2,576 tows gives detailed consideration to sampling problems and statistical methods. The most common larvae were rainbow smelt (Osmerus mordax), caught in about 50% of the tows and yellow perch (Perca flavescens), clupeids, and cyprinids, caught in about 10 to 20% of the tows. Most of the data contained too high proportions of zero catches to be transformed to approximately normal distribution, and were therefore analyzed using the low linear model rather than by analysis of variance. Except for cyprinids, larval fish seemed to be scarce in surface waters during the day. Small (4 to 10 mm long) smelt and perch larvae were caught more frequently in 526- than in 782-micro m mesh nets. Very few perch and cyprinid larvae longer than 10 mm were ever caught. This, and a more rapid decline of daytime than nighttime catches of larval smelt through the midsummer, suggests that the nets were avoided by at least the larger larvae. If avoidance of sampling gear is substantial, larval fish abundances may be overestimated in years of slow growth when the larvae remain catchable longer. There was no evidence that the recent industrial development at Nanticoke, Ontario, has affected larval fish abundances so far, but industrial stresses were low during this period. Natural fluctuations of average yearly catches are so large that only large changes can be detected even after several years of occurrence. (Moore-IVI)
W84-02429

DISTRIBUTION OF DIATOMS IN LAKE SUPERIOR SEDIMENTS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W84-02432

DISTRIBUTION OF LARVAL YELLOW PERCH (PERCA FLAVESCENS) IN NEARSHORE WATERS OF SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. Perrone, Jr., P. J. Schneeberger, and D. J. Jude.
Journal of Great Lakes Research, Vol. 9, No. 4, p 517-522, 1983. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Distribution, *Lake Michigan, *Perch, *Larvae, Nearshore processes, Fish management, Power plants, Fish populations, Lakes, Great Lakes, Spatial distribution, Temporal distribution.

Spatial and temporal distribution of larval yellow perch in southeastern Lake Michigan was described. Samples were collected during 1973-1981 with plankton nets and benthic sleds in water from 0.5 to 21 m deep. From mid-May to early or mid-July yellow perch larvae of less than 7.5 mm total length were numerous. Larvae taken before mid-June hatched from eggs spawned in inland waters, as opposed to Lake Michigan. Larvae appearing early occurred largely in shallow water, less than 1.5 meters in depth. Larvae caught later were mainly distributed in deeper water, greater than 6 meters. Larval perch abundance was similar at all bottom depths greater than 6 meters, was low in surface water during the day and low near bottom at night. Significantly more larvae were caught at night than during the day at 0.5 and 1.5 meter stations. This work was part of investigations of fish populations near the J. H. Campbell Power plant near Grand Haven, Michigan, and the D. C. Cook Nuclear Power Plant near Brigman, Michigan. (Baker-IVI)
W84-02433

NEARSHORE PHYTOPLANKTON OF HAMMOND BAY, LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. L. Brown, and B. A. Manny.
Journal of Great Lakes Research, Vol. 9, No. 4, p 523-529, 1983. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Nearshore processes, *Phytoplankton, *Lake Huron, *Hammond Bay, Bays, Population dynamics, Diatoms, Chrysophyta, Eutrophication, Algae, Great Lakes, Nutrients, Seasonal variation.

Phytoplankton were collected from a small, nearshore water intake at Hammond Bay four times per week from August 1973 to July 1975. The samples were used to predict the effects of increased nutrient loading on nearshore phytoplankton populations in northern Lake Huron. Phytoplankton density, taxonomic composition, and biomass in the nearshore waters followed predictable, seasonal fluctuations during each of two 12-month period. In June the density of total phytoplankton was high at 450-600 cells/mL. From January to April each year the density was low, from 60 to 210 cells/mL. The mean annual composition of the phytoplankton assemblage by number was 33% cryptomonads, 24% diatoms, 16% chrysophytes, 16% blue-green algae, and 10% green algae. Phytoplankton biomass was low through each year in the range from 0.09 to 0.66 g/cu m, resembling values which had been previously reported for Lake Superior. Pennate diatoms contributed 60-80% of the total biomass from December to April and in July. Phytoflagellates consisting of chrysophytes and cryptomonads accounted for 35% of the biomass during the entire study period. (Baker-IVI)
W84-02434

ABUNDANCE AND BIOMASS OF THE MEIOBENTHOS IN NEARSHORE LAKE MICHIGAN WITH COMPARISONS TO THE MACROBENTHOS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, and M. A. Quigley.
Journal of Great Lakes Research, Vol. 9, No. 4, p 530-547, 1983. 5 Fig, 8 Tab, 53 Ref.

Descriptors: *Biomass, *Nearshore processes, *Lake Michigan, *Benthos, Great Lakes, Macrobenthos, Nematodes, Aquatic animals, Detritus, Decomposing organic matter, Meiobenthos.

Cores were taken from 11, 17, and 23 meters at monthly intervals from May to November of 1976-79 in order to quantify the meiobenthos of nearshore southeastern Lake Michigan. The total meiobenthic abundance ranged from 69,700/ sq m to 1,300,000/sq m and total biomass ranged from 0.03 to 0.87 g/sq m. Nematodes accounted for 80% of all individuals and 66% of the biomass. In late spring to summer most of the major groups peaked in population density. However, some peaked in early spring and fall. Mean annual densities varied from two-fold to 12-fold at a given station with the exceptions of nematodes. More abundant life was noted for harpacticoids, tardigrades, and ostracods living at the deeper depths. Cyclopoids and cladocerans were less abundant at greater depths. No consistent relationship was found between sampling depth and the abundance of nematodes and rotifers. In many of the groups temporal and spatial variation appeared to be related to changes in the amount of bottom detritus. The overall macrobenthos:meiobenthos biomass ratio was 15:1 and ranged from 5:1 to 45:1 on an annual basis. (Baker-IVI)
W84-02435

VARIATIONS IN THE DISTRIBUTION OF SUSPENDED PARTICLES DURING AN UPWELLING EVENT IN LAKE MICHIGAN IN 1980,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. L. Bell, and B. J. Eadie.
Journal of Great Lakes Research, Vol. 9, No. 4, p 559-567, 1983. 4 Fig, 18 Ref.

Descriptors: *Upwelling, *Suspended sediments, *Lake Michigan, Great Lakes, Distribution, Sediments, Temperature effects, Transparency, Sediment transport, Thermal stratification, Path of pollutants.

The hypothesis that suspended fine-grained particles moving downslope within the nepheloid layer in Lake Michigan are periodically reintroduced into the nearshore and euphotic zones during upwelling events was tested. Upwelling currents did redistribute suspended materials within the nepheloid layer and also reintroduced these materials into the nearshore and epilimnion. Upslope transport and redistribution of these materials are indicated by the distribution patterns of temperature, transparency and total suspended materials. The suspended materials were apparently being mixed into the overlying water in the nearshore region and then deflected lakeward over the top of the encroaching water mass. Most of the return flow was above the thermocline. The distribution of temperature, transparency, and specific conductance all indicated a westward flow above the thermocline. The same turbidity patterns will not likely develop with each upwelling event, but will vary depending on the velocity, direction, and proximity to the bottom of the upwelling currents; the timing with respect to the maximum upwelling; the variations in the available suspended materials; and the degree of thermal stratification. Resuspension and the reintroduction of fine grained particulates into the euphotic zone through upwelling events can play a large role in the long term behavior and fate of persistent contaminants such as PCB. (Baker-IVI)
W84-02437

RELATIONSHIPS AMONG ZOOBENTHOS, SEDIMENTS, AND ORGANIC MATTER IN LITTORAL ZONES OF WESTERN LAKE ERIE AND SAGINAW BAY,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. A. Cole, and D. L. Weigmann.
Journal of Great Lakes Research, Vol. 9, No. 4, p 568-581, 1983. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Littoral zones, *Benthic environment, *Saginaw Bay, *Lake Erie, *Benthos, Great Lakes, *Sediments, Zoobenthos, Organic matter, Eutrophication, Tubificids, Chironomids, Macrophytes.

Samples were taken of zoobenthos and sediments from the littoral zones in western Lake Erie and Saginaw Bay. Mostly infaunal species of Tubifici-

dae and Chironomidae inhabited the littoral zones. A very significant correlation was noted between the abundance and mean size of zoobenthic groups and the particle size and organic content of sediments. The weight and mean size of zoobenthos were greatest in organically rich silts and clays and least in organically poor sands. The proximity of fine grained sediments greatly influenced the relative abundance and mean size of zoobenthos in sands. Sandy sediments next to muddy sediments had zoobenthic groups with weights and mean size similar to those in adjacent muddy sediments. Low to moderate densities of submerged macrophytes on muddy sediments had a small, non-significant impact on zoobenthic abundance and composition compared to similar sediments without macrophytes. In well mixed littoral zones with sediments of diameters less than 1.5 mm, particle size and organic matter in sediment may serve as a reliable index to standing stocks of zoobenthos. (Baker-IVI)
W84-02438

FOOD SELECTION OF THE CILIATED PROTOZOA, CONDYLOSTOMA VORTICELLA (EHRENBERG) IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, and M. Yasuno.
Japanese Journal of Limnology, Vol. 44, No. 3, p 184-189, July, 1983. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *Protozoa, *Lake Kasumigaura, *Japan, *Food, Aquatic animals, Algae, Eutrophication.

The food selection of a herbivorous ciliated protozoa, Condylostoma vorticella (Ehrenberg) was examined in November of 1980 using Ivlev's electivity index. This ciliated protozoa selectively fed on Synechococcus, Kirchneriella, Dictyosphaerium, Coscinodiscus, Cryptomonas, Chlamydomonas, and Gomphosphaeria, but rejected Closterium, Phormidium, Synedra, Tegrastrum, Dactylococcopsis, Scenedesmus, Aphanizomenon, Melosira, and Micractinium. The size and shape of algae were significant in the food selection process, but the taxonomical groups were insignificant. The ciliate fed efficiently on food particles between 15 micrometers and 40 micrometers in size, but not filamentous and spindlelike algae or algae with long spines. Colonies of Microcystis found most abundantly in this lake were preferably ingested by the ciliate. This ciliated protozoa is likely a significant link in the food chain between Microcystis and crustacean zooplankton. (Author's abstract)
W84-02479

2I. Water In Plants

TISSUE WATER RELATIONSHIPS OF CALLITRIS COLUMELLARIS, EUCALYPTUS MELLIODORA AND EUCALYPTUS MICROCARPA INVESTIGATED USING THE PRESSURE-VOLUME TECHNIQUE,
Melbourne Univ., Parkville (Australia). Dept. of Botany.
K. A. Clayton-Green.
Oecologia, Vol. 57, No. 3, p 368-373, 1983. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Drought resistance, *Plant water potential, *Callitris, *Eucalyptus, Osmotic potential, Turgor, Plant water content, Drought hardening, Australia.

Callitris columellaris is a tree of inland Australia typically occurring in areas of 450-650 mm average annual rainfall, where droughts are common. In south-eastern Australia a mixed association with E. microcarpa and E. melliodora is common. Field studies have revealed differences in the drought resistance of these species. Using the pressure-bomb to construct pressure-volume curves, a cellular basis of differential drought resistance was found in C. columellaries, E. melliodora, and E. microcarpa. Among these three species differences were found in bound water, relative water content and water potential at zero turgor, osmotic potential at full turgor and bulk modulus of elasticity. These parameters showed C. columellaris to be the most, and E. melliodora the least drought resistant of the three species. C. columellaris may have a greater drought resistance, because at low water potentials its foliar tissue has a greater desiccation resistance. This desiccation resistance would be enhanced by the greater percentage of bound water in C. columellaris compared with the eucalypts. Drought hardening may involve an increase in bound water content, dry weight: turgid weight ratio and a decrease in osmotic potential at full turgor and water potential at zero turgor. (Moore-IVI)
W84-02254

MODELING OF THE OXYGEN REGIME OF A FRESHWATER BODY DURING SUMMER HEATING,
Moscow State Univ. (USSR).
V. V. Alekseev, Yu. I. Gorbatov, A. O. Kokorin, and M. Ya. Lyamin.
Water Resources, Vol. 9, No. 4, p 345-355, July-August, 1982. 5 Fig, 24 Ref. Translated from Vodnye Resursy, No. 4, p 15-26, July-August, 1982.

Descriptors: *Dissolved oxygen, *Temperature effects, *Lakes, Cyanophyta, Chlorella, Climates, Seasonal variations, Water circulation, Eutrophication, Water quality, Water pollution effects.

Prediction of water quality under anthropogenic loads on a water body has become a most important scientific problem. Oxygen is one of the determining indicators of water quality. A mathematical model of the dynamics of oxygen was constructed taking into account the photosynthetic process. The theoretical data agree well with the results of experiments conducted. An approach to a description of processes occurring in the water body was proposed and some numerical characteristics were given. The need for a detailed examination of the carbonate cycle in water was shown. The model does not describe blooms caused by blue-green algae. According to the model, under any conditions Chlorella without mixing sinks to the lower layers of the water body, where the amount of light is insufficient for intense photosynthesis, and eventually dies. Upward movement of Chlorella occurs only by diffusion and is very little. The characteristic time of diffusion is almost two orders greater than the characteristic time of settling of the Chlorella particles. (Baker-IVI)
W84-02318

2J. Erosion and Sedimentation

CLAY MINERALOGY OF SEDIMENTS IN THE VAAL DAM AND IN THE RIVERS SUPPLYING AND DRAINING THE DAM UPSTREAM OF THE BARRAGE,
Geological Survey, Bellville (South Africa). Marine Geosciences Unit.
G. F. Birch.
Water South Africa, Vol. 9, No. 3, p 117-123, July, 1983. 8 Fig, 2 Tab, 7 Ref.

Descriptors: *Clays, *Drainage basins, *South Africa, *Wilge River, *Vaal Dam, *Vaal River, Sediments, Minerals.

Clays in the sediments from the Vaal Dam and from the Vaal and Wilge Rivers are mainly illitic (about 81%), with smaller quantities of smectite (about 16%) and kaolinite (about 4%). Chloritic clays are absent. A distinctive clay mineral distribution pattern can be related to the geology of the drainage basin. The drainage area is underlain by rocks predominantly of the Karoo Supergroup which, when eroded, liberate mainly illitic clay minerals. The breakdown of volcanic and feldspathic rocks of the Ventersdorp and Witwatersrand Supergroups in the north western part of the basin produce expandable smectitic clay minerals and kaolinite, respectively. The Vaal Dam and Vaal River downstream of the latter areas contain sediments which are enriched in smectite and kaolinite. Sediments in the lower reaches of the submerged Wilge River tributary are also enriched in kaolinite and smectite, probably due to mixing and diffusion of Vaal River water which is rich in these minerals. Although some of the rocks of the drainage basin contain chloritic clays, this mineral is not present in young sediments of the region, probably because it is unstable in the present-day environment. Vertical trends in the clay mineral abundance may represent an incomplete sedimentation cycle governed by differential settling rates of clay minerals. (Author's abstract)
W84-02312

DISTRIBUTION OF DIATOMS IN LAKE SUPERIOR SEDIMENTS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
V. L. Thayer, T. C. Johnson, and H. J. Schrader.
Journal of Great Lakes Research, Vol. 9, No. 4, p 497-507, 1983. 8 Fig, 1 Tab, 33 Ref. NSF grants OCE 78-08166 and OCE-8018339.

Descriptors: *Lake sediments, *Diatoms, *Distribution, *Lake Superior, Phytoplankton, Sedimentation rates, Bathymetry, Great Lakes.

Diatom frustules do not rain down uniformly onto the bottom of Lake Superior but are preferentially deposited in nearshore bathymetric depressions and some marginal bays. Regions containing relatively high diatom concentrations in the upper 50 cm of sediment include Thunder Bay, Thunder Bay trough, Keweenaw Bay, and the northshore trough. There is a paucity of diatom frustules throughout the upper 50 cm of open-lake sediments. Only a weak correlation was found between diatom concentrations in surface sediment and diatom biomass in the overlying waters. Diatom abundance was a function of bathymetry and distance from shore in the western half of Lake Superior, including Keweenaw Bay. The relationship between diatom abundance and water depth/offshore distance was not clearly defined in the valley and ridge region of southeastern Lake Superior. Diatom abundance increased with increasing sedimentation rate and proximity to the shore at the 10- and 20-cm horizons in the sediments. Diatoms were abundant in the surface sediment of areas with either low or high sedimentation rates. Fossil diatom concentrations in the western arm of Lake Superior were diluted by a high input rate of terrigenous sediment from the eroding Wisconsin shoreline. (Baker-IVI)
W84-02432

SEDIMENT DELIVERY PROBLEM,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling.
Journal of Hydrology, Vol. 65, No. 1-3, p 209-237, August, 1983. 13 Fig, 7 Tab, 87 Ref.

Descriptors: *Sediment transport, *Model studies, Erosion, Sedimentation, Channels, Spatial distribution, Nutrients, Drainage basin, Soil erosion.

The limitations of the sediment delivery ratio concept are reviewed by considering the problems of temporal and spatial lumping and its blackbox nature. Recent advances in the understanding of the sediment delivery system and its modelling are described and the lack of detailed empirical investigations is highlighted. The significance of recent concern for the role of sediments in the transport of nutrients and contaminants to sediment delivery studies is introduced. Appreciation of the wider enviromental significance of erosion and sediment delivery processes in the context of material transfer through terrestrial and aquatic ecosystems provides a further need for improved understanding of sediment delivery processes. The lack of empirical studies of the processes, pathways, sinks and time constants involved in the delivery process must hamper progress. Recent advances in distributive modelling of erosion and sediment yield clearly represent a significant advance. (Baker-IVI)
W84-02447

DISTRIBUTION FUNCTION APPROACH TO MODELLING BASIN SEDIMENT YIELD,
Institute of Hydrology, Wallingford (England).
R. J. Moore, and R. T. Clarke.

Journal of Hydrology, Vol. 65, No. 1-3, p 239-257, August, 1983. 8 Fig, 21 Ref.

Descriptors: *Sediment transport, *Model studies, *Sediment yield, Mathematical studies, Hydrographs, Erosion, Storm runoff.

The distribution function theory provides both a plausible description of sediment removal and translation as supply- and transport-limited processes, and a model structure suitable for automatic parameter optimization by gradient-based procedures. The exhaustion of sediment supplies during a storm event and the increasing availability of sediment as the inter-storm period lengthens are able to be represented by the mathematical description of accumulation of sediment and its removal by direct runoff. A linear convolution integral operation is used to accomplish translation of water and sediment to the basin outlet. An inverse Gaussian probability density function is proposed as a suitable two-parameter form for the instantaneous unit hydrograph. The relation of this distribution to the convection-diffusion equation, and its extension to represent settling out of sediment from suspension, are discussed. An extension of the distribution function model to incorporate a drainage (or baseflow) component is introduced as one means of representing hydrographs with protracted recessions. (Baker-IVI)
W84-02448

EVALUATION OF BED TRANSPORT AND RESISTANCE EQUATIONS IN FLUVIAL HYDRAULICS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Journal of Hydrology, Vol. 66, No. 1-4, p 269-290, October, 1983. 14 Fig, 1 Tab, 13 Ref.

Descriptors: *Sediment transport, *Fluvial sediments, *Resistance, Bed load, Sedimentation, Alluvial deposits, Hydraulics, Sediment deposition, Scour.

Because of the complexity and random nature of the problem of deposition and scour, the approaches of study are empirical or semi-empirical. Bed-load formulas give results which may differ by 100% or more. An extensive experimental investigation, inducing sedimentation and scour under various conditions, was conducted. The data analysis was utilized to examine the relative validity of the most popular bed-load formulas as well as those pertaining to flow resistance due to bed forms. A procedure involving a combination of the bed-load formulas and the appropriate resistance equation was devised to determine the sediment discharge. The procedure is intended for practical application. Among the popular bed-load formulas, Kalinske's equation gave the best correlation with the experimentally determined sediment discharge. The values of the energy slope, calculated by the resistance equations, are in reasonable conformity with the experimental values. A relatively better agreement was found for the starvation case than for sedimentation. In case of sedimentation the Chezy-Simons and Richardson approach gave the best agreement and the Liu-Hwang's approach was superior in case of scour. The procedure which combines the bed-load formulas and resistance equations produced reliable results for the conditions tested and, therefore, is recommended for practical application under the same conditions. (Baker-IVI)
W84-02471

2K. Chemical Processes

TRACING THE SOURCES OF THE CHEMICAL COMPOSITION OF PRECIPITATION BY CLUSTER ANALYSIS,
Netherlands Energy Research Foundation ECN, Petten.
J. Slanina, J. H. Baard, W. L. Zijp, and W. A. H. Asman.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 41-45, July 1983. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Chemistry of precipitation, *Cluster analysis, Hydrogen ion concentration, Air pollution, Netherlands.

Cluster analysis was applied to a precipitation chemistry data base obtained by sampling by means of 8 wet-only samplers on one location in the northwestern part of the Netherlands for sampling periods of 2 and 3 days. Two main groups were found, corresponding to either continental or maritime origin, which coincided with prior meteorological analysis. Each main group consisted of two subgroups. Polluted maritime air seems to be an important source of H(+), presumably due to the low NH3 concentration in maritime air and hence little neutralization of strong acids. (Author's abstract)
W84-02125

COMPARATIVE STUDY ON THE ELEMENTARY COMPOSITION OF FULVIC AND HUMIC ACIDS OF AQUATIC ORIGIN AND FROM SOILS AND MICROBIAL SUBSTRATES,
Laval Univ., Quebec. Dept. of Soil Sicence.
S. A. Visser.
Water Research, Vol. 17, No. 10, p 1393-1396, 1983. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Decomposing organic matter, *Water chemistry, Humic acids, Fulvic acids, Chemical composition, Soil chemistry, Laurentide Provincial Park, Quebec.

The elementary composition of molecular fractions of fulvic and humic acids sampled regularly during a 5 months period was investigated. The samples were taken at various locations in a watershed within the Laurentide Provincial Park, in Quebec. The investigation also included humic material produced by a streptomycete culture and sampled at regular intervals during a 6 months incubation period in order to study the effect of humification on the elementary composition. The aquatic humus had lower carbon and nitrogen and higher oxygen contents than humic compounds isolated from soils. Its fulvic and humic acids appeared to have more characteristics in common than is normally the case for terrestrial humus. During the course of the summer season it gradually became richer in carbon and poorer in oxygen. At least for recently formed material, fulvic acids became more oxidized with the process of progressive humification. Higher molecular weight fractions of the aquatic humic matter were also richer in oxygen than lower molecular weight material. (Baker-IVI)
W84-02189

IDENTIFICATION OF RUNOFF SOURCES OF A FORESTED LOWLAND CATCHMENT; A CHEMICAL AND STATISTICAL APPROACH,
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
J. J. H. M. Duysings, J. M. Verstraten, and L. Bruynzeel.
Journal of Hydrology, Vol. 64, No. 1/4, p 357-375, July, 1983. 4 Fig, 7 Tab, 34 Ref.

Descriptors: *Forest watersheds, *Precipitation, Seasonal variations, Rainfall, Statistical analysis, Storm runoff, Snowmelt, Hydrology, Catchment areas, Water chemistry.

The seasonal and intra-storm variations in streamwater chemistry are described and used to distinguish runoff and solute sources in the catchment. Sources of solutes include those contained in water from: throughfall falling on the river channel and adjacent partial areas; litter-layer water and water from the organic-rich sandy topsoil (A1 horizon); or throughflow in the sandy layer (A2 horizon). Statistical treatment of the streamwater concentration data by means of factor and cluster analysis show the significant relationships and different behavior of three groups of solute species: K, NH4, NO3/Mg, Na, Cl/Ca, Si, SO4, each group having a different response to rainfall. The first group, K, NH4, and NO3 shows an increasing concentration during the first part of a storm and a decrease afterward. The second, Na, Cl, and Mg shows a lowered concentration during the first part of a storm with increases after the discharge peak is reached. The third, Ca, Si, and SO4, group shows dilution on the rising limb and enrichment on the falling limb of the hydrograph. In winter and spring, however, Si and SO4 show an earlier increase in concentration in contrast to Ca. Three types of storm events with specific hydrologic situations could be distinguished: winter and spring storms generating direct runoff and baseflow; summer and autumn storms generating only direct runoff; and snowmelt runoff. Each of these types of runoff event is charactertized by a particular solute behavior, related to contributions from the different runoff and solute sources. The validity of this model of solute contributions by these sources (throughfall (stemflow), litter and soil waters) is corroborated by the measured concentration levels of these sources. (Baker-IVI)
W84-02215

OFF-FLAVOURS IN AQUATIC ECOSYSTEMS - AN INTRODUCTION,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5F.
W84-02267

ODOUR PROBLEMS IN TWO RESERVOIRS,
Water Research Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 5F.
W84-02269

STUDY OF THE SULFUR ISOTOPIC COMPOSITION OF GROUNDWATERS FOR SOLVING HYDROGEOLOGICAL PROBLEMS (WITH SPECIAL REFERENCE TO THE CHU-SARYSU ARTESIAN BASIN),
For primary bibliographic entry see Field 2F.
W84-02332

SORPTION ABILITY OF PEAT SOILS AND THEIR ROLE IN THE FORMATION OF THE COMPOSITION OF SOIL AND GROUNDWATERS,
Moscow State Univ. (USSR).
D. S. Orlov, and I. I. Lytkin.
Water Resources, Vol. 10, No. 1, p 41-52, January-February, 1983. 4 Fig, 5 Tab, 19 Ref. Translated from Vodnye Resursy, No. 1, p 81-93, January-February, 1983.

Descriptors: *Peat soils, *Water analysis, *Groundwater, Sorption, Minerals, Sulfides, Phosphates, Carbonates, Calcium, Peat bogs, Organic matter.

Peat bogs play a specific and considerable role in the formation of the composition of subsurface waters. They are distinguished by a high sorption ability, enrich water in organic matter, promote the development of reducing processes influencing the mobility of a number of elements, and are zones of accumulation of sulfides, carbonates, and phosphates. Data are listed concerning the physical and chemical properties of peat soils and the chemical composition of the soil and groundwaters of peat soils. The adsorption of cations and anions by peat soils under dynamic connditions from 0.05 N KCl and Ca(NO3)2 is tabulated. Peat soils and peat bogs play a dual role in the formation of the composition of certain natural waters. On the one hand they are powerful natural geochemical barriers on the path of migration of chemical substances and especially substances of a technogenic origin. On the other hand peat bogs supply the environment with a large amount of mineral and organic compounds with the soil and groundwaters. Waters of lowmoor peat bogs remove mainly mineral components, whereas waters of highmoor peat bogs remove a greater amount of organic matter. (Baker-IVI)
W84-02345

CHEMICAL COMPOSITION OF NATURAL WATERS AND ROCK WEATHERING IN THE IZU PENINSULA AREA AS AN INDEX TO EARTHQUAKE-CAUSED LANDSLIDES,
Miyasaki Univ. (Japan). Dept. of Civil Engineering.

For primary bibliographic entry see Field 8E.
W84-02477

ROCK WEATHERING ESTIMATED BY DISSOLVED CHEMICAL CONSTITUENTS IN LAND WATER; MARL AREA OF OKINAWA ISLAND,
Okinawa Inst. of Physicachemical Res., Okinawa City.
E. Tohyama.
Japanese Journal of Limnology, Vol. 44, No. 3, p 173-183, July, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Weathering, *Rocks, *Okinawa, Erosion, Chemical reactions, *Marl, Water analysis, Minerals, Water chemistry.

Shimajiri marl is a bluish-gray soft rock occurring widely in the southern part of Okinawa Island. Major minerals of soil derived from the marl include montmorillonite, kaolinite, illite and chlorite. Primary rock minerals found in marl are assumed to be feldspar, calcite, dolomite, gypsum, pyroxene, halite and so forth. Carbon dioxide containing waters in the marl area react with these primary minerals. Chemical constituents such as Ca, Mg, Na, K, HCO3, Cl, SO4 ions and soluble SiO2 are dissolved from the minerals into the natural waters with the eventual formation of clay minerals. An example of the chemical weathering of rock forming minerals is given. The amounts of weathered silicate minerals and clay minerals as well as primary minerals can be calculated from these chemical equations for weathering. For the Shimajiri marl area the calculations suggest the following: primary rock minerals weathered, 350 t/sq km/year; clay minerals formed, 120 t/sq km/year; and chemical species released, 340 t/sq km/year. (Baker-IVI)
W84-02478

2L. Estuaries

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: I. A CHARACTERIZATION,
Vermont Univ., Burlington. School of Natural Resources.
J. C. Clausen, and K. N. Brooks.
Water Resources Bulletin, Vol. 19, No. 5, p 763-767, October, 1983. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Peat bogs, *Fen, *Minesota, *Water quality, Runoff, Hydrogen ion concentration, Specific condustance, Alkalinity, Calcium, Magnesium, Ammonia, Acidity, Color, Aluminum, Humic acids, Fulvic acids, Vegetation, Chemical oxygen demand.

The likelihood of expanded use of Minnesota's 3 million hectares of peatlands prompted the state to initiate a hydrologic study to characterize these groundwater-linked systems. Determining the quality of streamflow from these peatlands was an integral part of the study. Peatlands could be differentiated either on the basis of streamflow quality or on soil-vegetation characteristics. The quality of streamflow from 45 undisturbed peatlands was characterized by collecting samples five times in 1979-1980 and analyzing them for 27 water quality characteristics. Runoff pH, specific conductance, alkalinity, calcium, and magnesium were used to classify the peatlands as bog, transition, or fen. Bog runoff was lower (alpha = 0.05) in pH, calcium, sodium, manganese, and ammonia nitrogen than fen runoff, but was higher in acidity, color, aluminum, humic and fulvic acid, and chemical oxygen demand than fen runoff. Bogs had more fibric peat of a lower pH than fens; fens exhibited tall woody shrubs which were virtually absent on bogs. (Author's abstract)
W84-02164

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: II. A METHOD FOR ASSESSING MINING IMPACTS,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 5B.
W84-02165

SEASONAL CHANGES IN THE FORMS AND SPECIES OF IRON AND MANGANESE IN A SEASONALLY-INUNDATED FLOODPLAIN SWAMP,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
L. A. Smock, and E. J. Kuenzler.
Water Research, Vol. 17, No. 10, p 1287-1294, 1983. 5 Fig, 37 Ref. North Carolina Water Resources Research Institute Grant B-110-NC.

Descriptors: *Swamps, *Iron, *Manganese, *Seasonal variation, Particulates, Colloids, Floodplains, Flooding, Suspended solids, Soil chemistry.

The forms and species in which Fe and Mn occurred in a seasonally-inundated Southeastern United States floodplain swamp were examined. The analytical scheme provided operational estimates of the concentrations of Fe(II), Fe(III) and Mn in particulate (>0.45 micro m), colloidal (0.45-0.0032 micro m) and ultrafilterable (<0.0032 micro m) size fractions. The procedure also provided a differentiation between forms of Fe that were readily reactive to bathophenanthroline (BPN) and those forms that were unreactive to BPN until undergoing acid extraction. Further, the concentrations of Fe and Mn associated with suspended particulate matter in ion-exchangeable, reducible, and oxidizable forms and as inert mineral were determined using an operational classification scheme. The ferric species predominated due to the oxygenated conditions of the swamp water. Concentrations of colloidal-sized, readily-reducible Fe and of ultrafilterable Fe(II) and Fe(III) were low (<0.25 mg/l) and fairly constant throughout the study; more Fe occurred in the colloidal than ultrafilterable size range. The majority of the colloidal-sized Fe was in an acid-extracted form. Almost all ultrafilterable Fe was ferric, although high Fe(II) concentrations occurred in floodplain soil pore water. Total Fe, mainly particulate-associated, varied with periods of flooding and intense bioturbation. Manganese occurred in low concentrations, primarily in the ultrafilterable fraction, although colloidal-sized Mn forms were important at times. Most of the Fe and Mn associated with suspended particulates occurred in the inert mineral form and to a lesser extent in a reducible form. Ion-exchangeable and oxidizable particulate Fe and Mn were relatively unimportant. (Author's abstract)
W84-02181

STOCHASTIC SIMULATION MODEL OF BROWN SHRIMP (PENAEUS AZTECUS IVES) GROWTH, MOVEMENT, AND SURVIVAL IN GALVESTON BAY, TEXAS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
L. C. George, and W. E. Grant.
Ecological Modelling, Vol. 19, No. 1, p 41-70, May, 1983. 6 Fig, 3 Tab, 45 Ref.

Descriptors: *Shrimp, *Simulation, Galveston Bay, Texas, Mortality, Growth, Population dynamics, Water temperature, Fisheries, Sport fishing, Commercial fishing, Stochastic studies, Model studies.

A stochastic simulation model of brown shrimp (Penaeus aztecus Ives) population dynamics in Galveston Bay, Texas, is described, validated, and used to evaluate the effects of management alternatives and changing environmental conditions on shrimp dynamics. The model is composed of submodels representing: (1) recruitment, (2) growth, (3) natural mortality, (4) fishing mortality, and (5) emigration of brown shrimp. The model predicts significant changes in total annual harvest from the food shrimp, bait, and recreational fisheries resulting from (1) closure of the bay system to all fishing except during the spring and fall open seasons, (2) two-week postponement of the opening and closing of the open seasons for the food shrimp fishery, (3) a 2.5 C increase and (4) a 2.5 C decrease in mean water temperature, (5) an 80% increase and (6) and 80% decrease in fishing effort. No significant change in the total annual harvest is predicted when the food shrimp fishing season is extended from May 15 through December 15. Sensitivity analysis suggests that field experimentation designed specifically to test the hypothesis of a 60-day time lag between brown shrimp recruitment into the bays and exposure to the fishery should receive high priority. Simulation results are discussed within a management framework. (Author's abstract)
W84-02236

NITRIFICATION MODEL WITH AN INHIBITORY EFFECT OF SEA WATER,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
D. Akai, O. Miki, and S. Ohgaki.
Ecological Modelling, Vol. 19, No. 3, p 189-198, July, 1983. 8 Fig, 7 Ref.

Descriptors: *Estuarine environment, *Nitrification, *Seawater, Bacteria, Mathematical models, Noncompetitive inhibition, Effluent, Water pollution effects, Salinity.

A dynamic model of nitrification including bacterial growth equations was developed for the understanding of nitrification in estuaries. Sensitivity analysis based on the model revealed that not only maximum specific growth rates of nitrifiers but also yield constants and initial bacterial concentrations have great effect on the nitrification process. Batch experiments were carried out in order to investigate nitrification rates and an inhibitory effect on nitrification by sea water. The maximum specific growth rate of ammonia oxidizing bacteria in fresh water was estimated as 0.04 (/h) using a nonlinear regression method. The sea water content of 10%, 25%, 50% and 100% reduced the maximum specific growth rate of ammonia oxidizing bacteria to 0.027, 0.016, 0.0085 and 0.0028 (/h) respectively. The effect of sea water on nitrification was interpreted as noncompetitive inhibition. Bacteria of freshwater strains can be acclimated to a brackish environment for a long period of time. However, when secondary effluent is discharged into an estuary and bay, little acclimatization can be expected for bacteria in the effluent. Salinity exerts a significant influence on nitrification. (Moore-IVI)
W84-02241

SEASONAL VARIATIONS IN THE HEAT ENERGY BUDGET OF THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
N. P. Smith.
Florida Scientist, Vol. 46, No. 3/4, p 168-178, 1983. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Heat budget, *Seasonal variation, *Indian River Lagoon, Florida, Water temperature, Heat storage, Solar radiation, Climate, Lagoons.

Meteorological records and water temperatures are used to describe annual variations in the heat budget of the Indian River lagoon, on the Atlantic coast of Florida. In the summer of 1979, water temperatures varied 1-2 C about the seasonal norm over time scales of about 1 wk. Heat stored in the lagoon was highly correlated with net isolation, net outgoing longwave radiation and sensible heat fluxes. In the winter of 1979-80, warming and cooling cycles varied temperatures + or - 3-4 C about the norm, and the storage term was significantly correlated with only the sensible and latent heat fluxes. (Author's abstract)
W84-02250

DIEL VARIATIONS OF DISSOLVED AMMONIA AND PHOSPHATE IN ESTUARINE SEDIMENT PORE WATER,
Harbor Branch Foundation, Inc., Ft. Pierce, Florida.
J. R. Montgomery, C. Zimmermann, G. Peterson, and M. Price.
Florida Scientist, Vol. 46, No. 3/4, p 407-414, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Estuarine environment, *Sediments, *Ammonium, *Phosphates, *Pore water, Hydro-

gen ion concentration, Nitrates, Photosynthesis, Indian River, Florida.

The sampling site was a Halodule wrightii seagrass bed at depths of 50-85 cm in the Indian River, Florida. Variations of dissolved ammonia and phosphate in pore water at depths of 2 to 40 cm were examined every 3 hr for 27 hr. Eh values were consistently negative and pH ranged from 7.2 to 8.0. Ammonium and phosphate were greatest at 10 cm and both steadily decreased to 40 cm. Maximum ammonium concentrations were 2.7 micro M in surface water and 169 micro M in the sediment. Maximum phophate concentrations were 6.4 micro M surface water to 30.4 micro M in sediment. Nitrate concentrations were 2.2 to 9.9 micro M at 2 cm and 0.1 to 0.8 micro M in surface waters. No nitrate was detected below 2 cm. Dynamic changes in the levels of phosphate and ammonium were observed during the period. It appears that dissolved reactive phosphorus and ammonium accumulate in sediment pore waters after photosynthesis ceases. (Moore-IVI)
W84-02252

ECOLOGICAL STUDIES ON THE FRESHWATER SHRIMP PALAEMONETES ANTENNARIUS OF LAGUNA DI LESINA (GARGANO, SOUTH ITALY),
Innsbruck Univ. (Austria). Inst. fur Zoophysiologie.
G. J. Dalla Via.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 227-239, June, 1983. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Salinity, *Shrimp, *Laguna di Lesina, *Italy, Temperature effects, Brackish water, Mediterranean Sea, Population dynamics, Lagoons, Reproduction.

The ecology of the Mediterranean fresh- and brackish water shrimp, Palaemonetes antennarius, was investigated at five localities in and around the Laguna di Lesina. Data are provided on its occurrence in the lagoon, its distribution with regard to salinity and temperature, its mortality, survival, fertility, and sex ratio. Among the 5 populations differences were found to exist in body length and sex ratio. At higher salinities growth is reduced which is considered to be due to increased costs of locomotion and maintenance. Conversely, egg development is favored by low salinities which causes the sex ratio to shift in favor of females from approximately 25% at the highest to 55% at the lowest salinity investigated. In a fresh water population (Lago di Garda) the female to male ratio is 3:1. P. antennarius avails itself of the ecological niche caused by frequent changes in salinity. No overlap with marine species was observed. (Author's abstract)
W84-02385

DIVERSITY: QUANTIFICATION AND ECOLOGICAL EVALUATION IN FRESHWATER MARSHES,
Wisconsin Univ.-Green Bay.
H. J. Harris, M. S. Milligan, and G. A. Fewless.
Biological Conservation, Vol. 27, No. 2, p 99-110, 1983. 1 Fig, 2 Tab, 38 Ref.

Descriptors: *Species diversity, *Marshes, *Birds, *Environmental quality, Green Bay, Wisconsin, Lake Michigan, Vegetation, Aerial photography, Edge diversity, Cover type diversity, Coastal areas.

The primary objective of this study was to test the usefulness of two indices - edge diversity and cover type diversity - in assessing bird species diversity for breeding avian communities in freshwater coastal marshes. Bird species diversity was used in this study as an indicator of ecological quality. Permanent transects in three marshes on the bay of Green Bay, Lake Michigan, provided the basis for vegetation assessments and breeding bird censuses. Four years of field data were subjected to regression analysis. The best equation was found to be a multiple regression of bird species diversity on cover type diversity and edge diversity, showing a significant linear relationship with cover type diversity and a significant curvilinear relationship with edge diversity. Cover type diversity and edge diversity can be readily assessed from aerial imagery. The results are most applicable to ecological evaluation where objectives stress species diversity rather than single-species management. (Author's abstract)
W84-02389

VERTICAL AND HORIZONTAL DISTRIBUTION OF MEIOFAUNA IN MANGROVE SEDIMENTS IN TRANSKEI, SOUTHERN AFRICA,
Transkei Univ., Umtata (Transkei, South Africa). Dept. of Zoology.
A. H. Dye.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 6, p 591-598, 1983. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Sediments, *Meiofauna, *Mngazana River, Transkei, South Africa, Depth distribution, Mangroves, Nematodes, Ciliates, Oligochaetes, Gastrotrichs, Polychaetes, Kinorhynchs, Crustaceans.

The depth-distribution profiles of meiofauna in four transects in the Mngazana estuary, Transkei were studied during summer 1980. Highest densities (1000/100 cu cm) were encountered within the top 10 cm of the sediment. Nematodes dominated (80%) and the remainder was made up of ciliates, oligochaetes, gastrotrichs and low numbers of polychaetes, copepods, kinorhynchs and various crustacean larvae. Among chemical parameters Eh correlated most consistantly with distribution, particularly at the lower tidal levels. Temperature and pH appeared to be of lesser importance. The maximum estimated depth of penetration was on average 72 cm at the HW levels; 32 at MW and 23 at LW. The mean dry biomass was estimated at 1073 mg/sq m; 941 mg/sq m and 196 mg/sq m at these tidal levels respectively. The meiofauna occurs to considerable depths, at least to the permanent water table. Sampling only the top 5 cm would yield approximately 40% of the total. Increasing the sampling depth to 30 cm at HWS and to 15 cm at MW would double this yield. (Moore-IVI)
W84-02398

SIGNIFICANCE OF SMALL SPECIES OF CHLOROPHYTA IN FRESHWATER PHYTOPLANKTON COMMUNITIES WITH SPECIAL REFERENCE TO FIVE WELSH LAKES,
University of North Wales, Bangor Gwynedd. School of Plant Biology.
J. Priddle, and C. M. Happey-Wood.
Journal of Ecology, Vol. 71, No. 3, p 793-810, November, 1983. 11 Fig, 2 Tab, 44 Ref.

Descriptors: *Chlorophyta, *Phytoplankton, *Lakes, *Wales, Llyn Cwellyn, Llyn Llydaw, Llyn Padarn, Llyn Coron, Llyn Maelog, Nutrients, Water quality, Mountain lakes, Mesotrophic lakes, Eutrophic lakes, Seasonal variation, Diatoms, Cyanophyta, Algal growth.

The significance of small green algae, of cell volume about 100 cu micro m, in freshwater phytoplankton was studied over an annual cycle in five lakes in North Wales which varied widely in nutrient status. Two-weekly samples from the lakes were analysed for seven water-quality variables, total phytoplankton biomass and the abundances of 131 algal taxa. The small Chlorophyta included both motile and non-motile species of Chlorococcales and Volvocales. Ankistrodesmus falcatus was the most cosmopolitan species and occasionally exceeded 1000/cu cm in all five lakes. Chlorella minutissima, C. vulgaris and Scenedesmus graheinsii also occurred in all the lakes studied but were less common than Ankistrodesmus falcatus. Some small species of Chlamydomonas and Chloromonas were restricted to one or two of the lakes. The mountain lakes, Llyn Cwellyn and Llyn Llydaw in Snowdonia had nutrient-poor waters supporting phytoplankton populations of low density. Species of small Chlorophyta were dominant numerically in the phytoplankton and were present throughout the year. The median proportions of numbers of small Chlorophyta of the total number of all other phytoplankton taxa were 87% and 91% for Llyn Cwellyn and Llyn Llydaw, respectively. Llyn Padarn, a mesotrophic lake, had a greater phytoplankton biomass than the two mountain lakes. The phytoplankton exhibited distinct seasonal periodicity, with the spring diatom growth followed by a population of Oscillatoria limnetica during the summer, and further diatom growth in the autumn. Small Chlorophyta were present through the year with population densities exceeding 10000/cu cm during the summer. The median proportion of small Chlorophyta of the total number of all phytoplankton taxa was 70%. Llyn Coron and Llyn Maelog, situated in agricultural catchments on Anglesey, were nutrient-rich; their water samples contained high concentrations of nitrogen, phosphorus and silicon compounds, particularly in the late summer and autumn. The succession of phytoplankton was dominated by taxa of larger-celled algae, mainly diatoms and buoyant blue-green algae. The phytoplankton density (as chlorophyll a) exceeded 100 mg/cu m during the spring and summer. Small Chlorophyta attained their maximum population densities, greater than 1000 organisms/cu cm, during the winter and early spring when the larger-celled algae were not recorded or were present only at low densities. During the summer the standing crop density of planktonic small Chlorophyta was low in these eutrophic lakes. (Author's abstract)
W84-02400

GROUND WATER AND THE EVOLUTION OF PATTERNED MIRES, GLACIAL LAKE AGASSIZ PEATLANDS, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W84-02401

SEDIMENTOLOGY AND GEOCHEMISTRY OF RECENT SEDIMENTS OFF THE MOUTH OF THE NIAGARA RIVER, LAKE ONTARIO,
Canada Centre for Inland Waters, Burlington, Ontario.
For primary bibliographic entry see Field 2H.
W84-02405

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SINGLE-STAGE SEAWATER DESALINATION AT HIGH TEMPERATURE AND SALINITY AS PRESENT IN THE MIDDLE EAST USING PEC-1000 MEMBRANE MODULES,
Toray Industries, Inc., Shiga (Japan).
M. Kurihara, Y. Nakagawa, H. Takeuchi, N. Kanamaru, and T. Tonomura.
Desalination, Vol. 46, p 101-110, May, 1983. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Seawater, Salinity, Water temperature, Red Sea, Arabian Gulf.

In the Middle East, where desalination is needed most urgently, both salinity and temperature of the seawater are very high, presenting problems for reverse osmosis (RO) desalination. Performance and long-term durability tests were carried out at a demonstration test facility using single-stage seawater reverse osmosis (SWRO) at high salinity and temperature, using PEC-1000 membrane modules. Since the seawater salinity at the test facility is 3.5 % TDS, and the seawater salinity in the Middle East (Red Sea and Arabian Gulf) is about 4 to 5 %, a part of the brine rejected from the RO modules is recycled to control the feed water salinity for the tests. Based on the long-term field test results, PEC-1000 membrane elements exhibit sufficiently enough performance and durability for the complete single-stage seawater RO in the Middle East and the permeate salinity is low enough for the WHO standard (500 ppm TDS) even at high water recovery rate such as 35-40 %. (Moore-IVI)
W84-02150

CALCULATION OF LIMITING CURRENT DENSITY OF ELECTRODIALYSIS UNDER THE INFLUENCE OF WATER QUALITY AND TEMPERATURE,
Lanzhou Municipal Engineering Designing Inst. (China).
S. Xutong, and C. Guang.
Desalination, Vol. 46, p 263-274, May, 1983. 4 fig, 2 Tab, 6 Ref.

Descriptors: *Electrodialysis, *Desalination, *Limiting current density, Dissolved solids, Saline water, Water temperature.

Limiting current density (LCD) is an important performance index of electrodialysis equipment. When water with the same amount of TDS (total dissolved solids) but different in nature and temperature is being desalted in the same type of electrodialyzer, the LCD varies drastically. The water type coefficient for LCD is the ratio of LCD for different water types under the same electrodialysis conditions. The coefficient varies with water type, concentration of TDS, water temperature and type of membrane. For electrodialyzers with the same kind of membranes, the water type coefficient for LCD at 0 degrees C is only related to the kind of membranes, and is not affected by the concentrtion of TDS, equipment size or flow rate; it is a constant. Tests were carried out on the value of LCD using two electrodialyzers of different type. On the basis of the measured value of LCD for saline water, the values of LCD for other water types under different conditions can be calculated. The absolute values of relative error between measured and calculated values range from 0.15% to 12.2%, with an average error of 5.6%. (Moore-IVI)
W84-02152

TEMPERATURE DEPENDENCE OF MEMBRANE TRANSPORT PARAMETERS IN HYPERFILTRATION,
Max-Planck-Inst. fuer Biophysik, Frankfurt am Main (Germany, F.R.).
J.-Y. Chen, H. Nomura, and W. Pusch.
Desalination, Vol. 46, p 437-446, May, 1983. 4b Fig, 3 Tab, 15 Ref.

Descriptors: *Membrane processes, *Hyperfiltration, *Desalination, Water temperature, Membrane transport, Permeability, Salt rejection.

Using three homogeneous (CA/F-700, K-700, L-700) and two asymmetric flat sheet membranes (B-9 and SOLROX SC-200) as well as a homogeneous strong ion exchange (CK-1) and a composite membrane (Teijin PBIL), the temperature dependence (0 C $<T<$ 40 C) of the transport parameters of the phenomenological relationships of the thermodynamics of irreversible processes, such as the hydrodynamic and osmotic permeability, and the asymptotic solute rejection, was determined from hyperfiltration experiments with 0.1 M NaCl brine solution. The salt rejection of the Ca and PBIL membranes is nearly independent of the temperature whereas the salt rejection of the SOLROX and CK-1 membranes increases with increasing temperature. The volume fluxes increase with increasing temperature for all membranes. The activation energies of water and salt transport for the different membranes used were then evaluated from the experimental data. Using aqueous KCl, MgCl2, and K2SO4 solutions, the data were supplemented by the experimentally determined enthalpies of dissolution at infinite dilution of the salt in homogeneous CA membranes. (Moore-IVI)
W84-02153

NON-CONVENTIONAL WATER SOURCES FOR SMALL REMOTE COMMUNITIES IN DEVELOPING COUNTRIES,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
A. M. Abulnour, M. H. Sorour, F. A. Hammouda, and A. M. Abdel Dayem.
Desalination, Vol. 47, p 285-292, May, 1983. 1 Fig, 3a Tab, 3 Ref.

Descriptors: *Developing countries, *Desalination, Drinking water, Potable water, Water reuse, Water management, Energy, Social aspects, Public participation, Egypt.

In Egypt, thousands of small communities are scattered in the desert and remote sea shores where conventional water sources are scarce. Means for providing clean water are vital. Further, water management and reuse schemes must be developed. Key issues to be considered when planning water supply systems include: the supply of water for drinking and cooking as a minimum; the possibility of using lower quality water for other uses by reuse; the level of technology in remote locations; the use of renewable energy sources; and sociocultural factors. The selection of potable water supply for small remote dispersed communities depends upon the specific nature of each community. Technologies based upon renewable energy should be encouraged to meet the increasing prices of fossil fuels. The potential prospects of photovoltaic systems should be considered. Any proposed solution should guarantee community participation as well as the required social orientation. Developing countries should encourage the application of these technologies by providing and encouraging the national skills as well as permitting maximal technology transfer. (Moore-IVI)
W84-02155

3B. Water Yield Improvement

PHOTOCATALYTIC FIXATION OF NITROGEN BY AQUEOUS SUSPENSIONS OF SILVER IODIDE,
Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. per la Nucleazione degli Aerosoli.
G. L. Petriconi, and H. M. Papee.
Water, Air, and Soil Pollution, Vol. 20, p 273-276, 1983. 2 Fig, 22 Ref.

Descriptors: *Nitrogen fixation, *Precipitation, *Cloud seeding, Silver iodide, Silver chloride, Chemical reactions, Photolysis, Ultraviolet radiation.

Silver iodide is the most common ice nucleant for supercooled water which now is used in weather modification and thus tons of that compound are dispersed in the air every year. Ultraviolet photolysis of silver iodide crystals was carried out in the laboratory with the expected result of nitrogen fixation. Yields of ammonium were better under experimental conditions in nitrogen than in air. At longer times of irradiation a stationary state or a decay of the ammonium concentrations ensued. This was also substantiated by the behavior of suspensions of silver chloride when irradiated in air. The aim of the present work, to show that the formation of some ammonium may be expected to occur during photolyses of silver iodide and that this substance may thus photofix nitrogen either from the gas or from the air, was accomplished. This process was compared with the corresponding behavior of silver chloride as well as considering some possible products of silver iodide decomposition. (Baker-IVI)
W84-02132

3C. Use Of Water Of Impaired Quality

PREVALENCE OF VIRAL HEPATITIS AND OTHER ENTERIC DISEASE IN COMMUNITIES UTILIZING WASTEWATER IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal.
Water Science and Technology, Vol. 15, No. 5, p 43-58, 1983. 6 Fig, 2 Tab, 12 Ref. EPA grant R-805174.

Descriptors: *Wastewater irrigation, *Epidemiology, *Hepatitis, *Enteric diseases, *Israel, Viruses, Effluents, Aquaculture, Shigellosis, Salmonellosis, Public health.

A retrospective epidemiological study was carried out on the association between enteric disease incidence and wastewater utilization in agriculture in 79 kibbutzim (cooperative agricultural settlements) in Israel. Medical records on disease incidence were collected directly from the patient files at the clinic of each kibbutz while environmental data was obtained from a detailed questionnaire. The kibbutzim included in the study were divided into four categories: I. thirty irrigating with wastewater effluent (population: 13,531), II. twenty-eight not utilizing effluent for any purpose (population: 11,0960, III. ten using wastewater effluent as feed-water from fish ponds (population: 5,005), and IV. eleven which practiced two consecutive years of effluent utilization and another two consecutive years in which no effluent was utilized for any purpose or vice versa (population: 3,040). No excess in crude rates of viral hepatitis was found in effluent utilizing kibbutzim (categories I and III) when compared to non-effluent utilizing kibbutzim (category II). A significant ($P<0.1$) excess of shigellosis was found in all ages in effluent irrigating kibbutzim (I) (during the irrigation period), while a significant ($P<0.01$) excess of salmonellosis was found in kibbutzim using effluent as feed-water for fish ponds (III). In the switch category (IV) there was an observed excess in crude rates of hepatitis in effluent years for age groups 5-18, 19+ and 'all ages,' although the numbers are too small to detect statistically significant differences. Despite the evidence that there was an excess of enteric diseases in kibbutzim during the period of exposure to effluent, the annual excess risk for all ages was nil or quite small, indicating that the overall risk of enteric disease resulting from effluent irrigation in kibbutzim in Israel is not a public health problem in general, though it might become one during epidemic periods. (Moore-IVI)
W84-02258

3E. Conservation In Industry

WATER RESOURCES, CURRENT CHARACTERISTICS, AND PROSPECTS OF WATER CONSUMPTION IN THE USA,
For primary bibliographic entry see Field 6D.
W84-02348

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

LOG PEARSON TYPE-3 DISTRIBUTION: PARAMETER ESTIMATION,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and M. A. Hira.
Journal of Hydrology, Vol. 64, No. 1/4, p 25-37, July, 1983. 4 Tab, 13 Ref.

Descriptors: *Flood control, *Flood frequency, Prediction, Estimating, Frequency analysis, Probability distribution, Mathematical studies, Simulation.

The log-Pearson type-3 (LP3) distribution was recommended as a base method for flood frequency analysis. Four additional methods for the estimation of the LP3 parameters, are presented. An attempt was also made to provide a suitable computational scheme for each of the methods. A simulation study was carried out using six sets of values for the parameters, selected to be in the range of those obtained from the Canadian rivers. Using a relatively large number of replications, the mean and standard deviation of relative errors committed in estimating the three parameters corresponding to each method were computed. The results indicate that when three of two moments of the transformed data are used, the resulting methods, namely the WRC (Water Resources Council method), MM3 and MM4 (mixed moments 3 and 4) produced unreliable estimates for the parameters. The method recommended by Bobee did not perform well. Among the remaining three methods, MM2, which is based on the first two moments of

original data and the variance of the log-transformed values provides the best estimates, which are only slightly better than those obtained by the method of maximum likelihood. (Baker-IVI)
W84-02199

FLOODPLAIN MANAGEMENT: STAGE OR DISCHARGE (GESTATION DES PLAINES INONDABLES: HAUTEUR OU DEBIT),
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
N. El-Jabi, and J. Rousselle.
Journal of Hydrology, Vol. 64, No. 1/4, p 93-102, July, 1983. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Flood control, *Model studies, Stochastic processes, Mathematical studies, Probabilistic process, Flood frequency, Floods, Riviere des Prairies.

A stochastic model based on the recent developments in the theory of extreme values is presented to describe the flood occurrence. This model is applied to the Riviere des Prairies, assuming that the exceedences (flood peak and/or stage above a given base flow and/or base stage) are independent and identically distributed in the time interval for a given year and season. (Author's abstract)
W84-02203

SEEPAGE FROM CANALS HAVING VARIABLE SHAPE AND PARTIAL LINING,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
A. Mirnateghi, and J. C. Bruch, Jr.
Journal of Hydrology, Vol. 64, No. 1/4, p 239-265, July, 1983. 9 Fig, 4 Tab, 8 Ref.

Descriptors: *Canals, *Seepage, Linings, Flow, Water supply development, Impervious membranes, Water management, Mathematical models.

The numerical models presented here are solutions to the steady two-dimensional flow through a porous medium from canals of variable shape with partial lining. Two main cases are studied. The first case is the seepage flow from canals with impervious lining on their sloping sides. The second case is for seepage from canals in which the impervious lining is located on the base of the canal and the sides are unlined. The Baiocchi transformation and method is used to develop a boundary value problem which is then solved by the finite-difference successive over-relaxation method with projection. A sample problem of each case is presented. The discharge rates and free surfaces of the seepage flows are obtained through the numerical scheme, and are compared with available analytical results. The formulation proved to provide a simple and efficient numerical scheme as opposed to the more complex and inefficient analytical solutions which use mapping techniques. The scheme also proved to be accurate, both the discharge rates and the free surfaces obtained were close to the analytical values obtained by mapping techniques. The numerical algorithms presented are also flexible and could be easily modified for canals of various cross sectional shapes. (Baker-IVI)
W84-02211

ASSESSMENT OF COMMONLY USED METHODS OF ESTIMATING FLOOD FREQUENCY,
D. W. Newton, and J. C. Herrin.
Transportation Research Record, No. 896, p 10-30, 1983. 19 Fig, 8 Tab, 23 Ref.

Descriptors: *Flood frequency, *Prediction, Statistical analysis, Flood flow, Tennessee Valley, Estimation, Flood peak.

Efforts to determine what are likely to be the most accurate and consistent procedures for determining peak flood flow frequencies for ungaged watersheds in the Tennessee Valley region are described. Information developed during a pilot test, which is currently the most comprehensive and objective method available of examining the performance of commonly used procedures for estimating peak flow frequencies at ungaged locations, formed the basis for this investigation. There were significant differences in performance when procedures were evaluated by using the criteria of accuracy, reproducibility, and practicality. Although the pilot test evaluation was limited to the Midwest and Northwest, the observed differences in performance result from fundamental differences in procedure formulation that can be expected to occur in the Tennessee Valley and in other regions as well. The most accurate and reproducible procedures evaluated were regression-based procedures in which prediction equations are calibrated to flood-frequency determinations at gaged locations by using statistical estimating procedures. The most obvious reasons for this superior performance are the definition of the parameters and the formulation of the prediction equation. The procedures that performed best (a) used parameters that were well-defined and could be consistently determined, (b) were formulated so that the flood-frequency estimates were not sensitive to parameter variations, and (c) were calibrated to a large number of gage records in a relatively small, well-defined hydrologic region. (Baker-IVI)
W84-02222

MAGNITUDE AND FREQUENCY OF URBAN FLOODS IN THE UNITED STATES,
V. B. Sauer, W. O. Thomas, Jr., V. A. Stricker, and K. V. Wilson.
Transportation Research Record, No. 896, p 30-33, 1983. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Flood frequency, *Urban areas, Estimating, Regression analysis, Mathematical studies, Storm runoff, Drainage basins, Rainfall intensity, Channels, Data collections.

With urban growth and development, there is an ever-increasing need for flood information and estimating techniques for use in areas where little or no data exist. A nationwide study of flood magnitude and frequency in urban areas included reviewing available literature, compiling an urban flood data base, and developing methods of estimating urban flood-flow characteritics in ungaged areas. The literature review contains synopses of 128 recent publications related to urban flood flow. A data base of 269 gaged basins in 56 cities and 31 states, including Hawaii, contains a wide variety of topographic and climatic characteristics, land use variables, indices of urbanization, and flood-frequency estimates. Regression equations were developed that provided unbiased estimates of urban flood discharges for ungaged sites for recurrence intervals, of 2, 5, 10, 25, 50, 100, and 500 years. Of primary importance is an independent estimate of the equivalent rural discharge for the ungaged basin. The equations adjust the equivalent rural discharge to an urban condition. The primary adjustment factor, or index of urbanization, is the basin development factor. This factor is a measure of the extent of development of the drainage system in the basin and includes evaluations of storm drains, channel improvements, and curb-and-gutter streets. It offers a simple and effective way of accounting for drainage development and runoff response in urban areas. Other parameters in the equations include size of drainage area, channel slope, rainfall intensity, lake and reservoir storage, impervious area, and basin lag time. (Baker-IVI)
W84-02223

DRAINAGE CONTROL THROUGH VEGETATION AND SOIL MANAGEMENT,
E. J. Kent, S. L. Yu, and D. C. Wyant.
Transporation Research Record, No. 896, p 39-47, 1983. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Highways, *Drainage systems, Rainfall-runoff relationships, Soil properties, Runoff, Vegetation, Infiltration, Detention reservoirs, Drainage basins, Frequency distribution, South Carolina.

A procedure is developed that promotes the use of soil infiltration capacity and available soil profile storage in the design of highway drainage systems. By considering a design volume represented by the soil profile storage, the dependence on constructed runoff detention basins or other drainage structures can be reduced. This design volume is selected as the antecedent available storage in the soil that produces the T-year runoff from the T-year design rainfall. Data requirements of the overall methodology are commonly available soils, vegetation, and climatic parameters. The influence of antecedent moisture on the relation between rainfall and runoff frequency was tested by using 5 years of daily soil moisture and hourly rainfall and 10 years of hourly runoff data from the Calhoun Experimental Forest near Union, South Carolina. Equations that estimate the design antecedent moisture and its associated storage for ungaged sites are developed. Vegetation and soil management techniques that increase the volume of soil profile storage and soil infiltration capacity are reviewed. In addition, the Calhoun soil moisture data are fitted to frequency distributions to assess the risk involved in using soils-based drainage designs. (Author's abstract)
W84-02225

CONTROL OF THE LEVEL OF LAKE ISSYK-KUL,
Zh. Kulzhabaev.
Water Resources, Vol. 9, No. 4, p 364-370, July-August, 1982. 3 Fig, 1 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 41-47, July-August, 1982.

Descriptors: *Water level, *Water resources development, *Lake Issyk-Kul, USSR, Water level fluctuations, Irrigation, Water demand, Diversion, Water management.

The main consumer of water in the basin of Lake Issyk-Kul is irrigation, which accounts for more than 90% of the runoff being withdrawn. In the future it is planned to increase the areas of irrigation to meet the needs of the local population and vacationers for agricultural products, which is related to the decision of directive agencies concerning the creation on the lake of a resort zone of national importance. The level of a closed lake can be controlled by acting either on the income part of the water balance or on the outgo part. The range of fluctuations of the level of Issyk-Kul is small. The problem of optimal control of the lake level in a steady-state regime is considered, that is, when the conveyance capacity of the diversion route and nonreturnable withdrawals reach a maximum value, whereupon the steady state condition does not mean that in the future the level regime of the lake will not change. There is a need for a rapid decrease of the deficit of the water balance of Lake Issyk-Kul by diverting water from adjacent rivers to its basin. The proposed method of calculation makes it possible to substantiate both the amount of additional inflow to the lake and the optimal strategy of diverting waters. Accordingly the conveyance capacity of the diversion route which permits maintaining the lake level within the prescribed interval of heights with a given probability can be determined. Optimum control of the Issyk-Kul level requires that the capacity of the diversion route substantially exceeds the average long-term volume of diversion. This will make it possible to markedly reduce the natural range of fluctuations of the lake level caused by variability of components of the water balance. (Baker-IVI)
W84-02319

PROBLEM OF WATER SUPPLY OF THE USSR AND INTERREGIONAL REDISTRIBUTION OF WATER RESOURCES,
G. V. Voropaev.
Water Resources, Vol. 9, No. 6, p 571-593, November-December, 1982. 7 Fig, 1 Tab. Translated from Vodnye Resursy, No. 6, p 3-28, November-December, 1982.

Descriptors: *Water supply development, *Water management, *USSR, Management, Groundwater, Soil water, Brackish water, Mass transfer, Heat transfer, Water shortage, Distribution, Water supply, Reviews.

Various studies have been carried out in the Soviet Union regarding the supply of adequate water. The evaluations of the current state of natural waters were refined and their qualitative and quantitative

changes as a result of the man's impact were predicted. The estimate of the subsurface water resources was refined, additional reserves of brackish waters were revealed, and the storage of productive soil waters was analyzed. A comprehensive evaluation was made of the changes in the natural conditions in the zone of probable withdrawal of the runoff, making it possible to establish the allowable withdrawals from northern and Siberian rivers and to correct the projects underway. The need for a radical reorganization of the country's entire water management program was recognized as the understanding that simple dilution of wastes is not sufficient to restore adequate water quality. Diversion of water to Central Asia and Kazakhstan should be examined primarily in connection with the development of productive forces of the entire Middle Region of the country. On the basis of the mass and heat transfer of the river runoff and waters of northern seas, the planned withdrawals will not introduce changes in the heat balance of the region, but will cause definite changes in the mouth regions of rivers and seas. The solution of the diversion problem is impossible without the development, investigation and consideration of other hypotheses of water supply of the economy. (Baker-IVI)
W84-02335

METHODOLOGICAL PRINCIPLES OF MANAGING THE HYDROLOGIC REGIME OF THE INLAND SEAS AND LAKES,
D. Ya. Ratkovich.
Water Resources, Vol. 7, No. 6, p 593-620, November-December, 1982. 5 Fig, 6 Tab, 27 Ref. Translated from Vodnye Resursy, No. 6, p 29-58, November-December, 1982.

Descriptors: *Water supply development, *Water demand, *USSR, Water use, Lakes, Inland seas, Management, Resources development.

The majority of large river systems of the European USSR, Central Asia, and Kazakhstan empty into inland seas - closed and drainage. The increasing development of the areas, particularly for agricultural purposes, has caused changes in the natural regime of these seas as the inflow of water to them is decreasing. A new national economic problem developed as a result of these changes and efforts were made to control the regime of seas for purposes of optimization of use. Three classes of water bodies differing in the character of their regime were subject to investigation: closed (where the outgo part of the water balance includes only evaporation from the surface), open (where the outgo part of the balance includes along with evaporation the lake runoff functionally related to the level), and drainage, connected with the World Ocean where changes in the mean annual level can be neglected. The solution of the problems requires comprehensive investigations: hyrological, hydrochemical, and hydrobiological. Measures for controlling the level and average salinity are already the object of design. (Baker-IVI)
W84-02336

CURRENT PROBLEMS OF THE CREATION, MULTIPURPOSE USE, AND INVESTIGATION OF RESERVOIRS,
A. B. Avakyan.
Water Resources, Vol. 9, No. 6, p 621-635, November-December, 1982. 4 Fig, 3 Tab, 12 Ref. Translated from Vodnye Resursy, No. 6, p 74-92, November-December, 1982.

Descriptors: *Reservoirs, *Water resources development, Design criteria, Site selection, Powerplants, Training, Reservoir operation, Maintenance, Water supply.

Streamflow regulation by reservoirs and interbasin transfer of waters with their storage are seen as realistic methods of meeting the increasing demand for water in the majority of the world's regions. Reservoirs in themselves are complex in their structure and operation. The development of thermal, nuclear, and pumped-storage power stations challenges investigators of reservoirs with new problems. Solving many water resource problems and eliminating or mollifying conflicts arising during water resources management along with the creation and operation of reservoirs generates new conflicts between the sectors of water resource management. Intrasector conflicts are particularly apparent in the requirements imposed on water resources of reservoirs and regimes of releases and levels downstream of hydrostations. The impact of reservoirs on the environment is considered. Proper operator training is seen as a must for proper management. Cost effectiveness of various plans should be carefully considered at the design stage. Resettlement of inhabitants and compensation for confiscated lands, structures and other immovable property must be handled carefully and often becomes extremely complex. (Baker-IVI)
W84-02337

GRASSY SWALES PROVE COST-EFFECTIVE FOR WATER POLLUTION CONTROL,
Post, Buckley, Schuh and Jernigan, Inc., Tampa, FL.
W. C. Kercher, Jr., J. C. Landon, and R. Massarelli.
Public Works, Vol. 114, No. 4, p 53-54, April, 1983. 1 Fig, 3 Tab.

Descriptors: *Storm runoff, *Flood control, *Grassed waterways, *Grassy swales, Grasses, Water pollution control, Urban areas, Suburbs, Stormwater, Mosquitoes, Rockledge, Florida.

Evidence that grassy swales are cost effective for reducing stormwater runoff and for achieving water quality and control objectives is presented. The test site encompassed 12.7 acres of a single family residential subdivision located in Rockledge, Florida. It contains 41 single family homes, 10 vacant lots, no construction activity and portions of three roads. The soils are Myakka, Urban and Canaveral. Thirteen storm events were available for study. The grassy swale system removed 99% of the pollutants measured. In comparison with a residential drainage system in a neighboring community, the swale system greatly reduced offsite stormwater runoff. The swale system was less expensive to construct, required a smaller percentage of land area and requires less maintenance by local governments. Mosquito breeding in properly designed and maintained residential grassy swales will be minimal, as there will be no standing water. (Baker-IVI)
W84-02354

ODESSA SOLVES A WATER PROBLEM - IN A HURRY,
City Engineering Dept., Odessa, TX.
R. E. Klink.
Public Works, Vol. 114, No. 11, p 58-60, November 1983. 8 Fig, 1 Tab.

Descriptors: *Water supply development, *Population density, Odessa, Texas, Water supply, Water pressure, Pressure, Water tanks, Pipelines.

Odessa is a city in western Texas with a population of about 90,000 and over 35 sq mi in area. The town incurred an extremely rapid period of growth from the mid 1970s to the early 1980s causing a potential water shortage for a significant segment of the population. The following facilities were recommended as potential solutions to the problem: one new one-million gallon elevated water storage tank to be built 145 ft tall; a new two-million gallon ground water storage tank to be installed; one new 4.7 mgd booster pump station to be built with the capability to be easily expanded to an ultimate capacity of 14 mgd, and over one mile of water transmission lines to be built. This major public works improvement normally would have taken over two years to complete, was completed in approximately one year, due to the use of a 'fast-track' method. (Baker-IVI)
W84-02363

WATERSHED-WIDE APPROACH SIGNIFICANTLY REDUCES LOCAL STORMWATER MANAGEMENT COSTS,
Camp, Dresser and McKee, Inc., Annandale, VA.
J. P. Hartigan.
Public Works, Vol. 114, No. 12, p 34-37, December, 1983. 3 Fig, 1 Tab.

Descriptors: *Erosion control, *Channel construction, *Storm runoff, Runoff, Rainfall, Erosion, Land development, Economic aspects, Detention reservoirs.

Two approaches are described for controlling post-development runoff within downstream channels without causing significant channel erosion. Onsite control involves construction of individual stormwater detention facilities on each development site. These facilities are designed and constructed by the individual land developers to maintain peak runoff at predevelopment levels. The second approach involves constructing a single stormwater detention facility to control post-development runoff from several land development projects, and providing stream channel improvement where necessary upstream of the stormwater detention facility. Most of the advantages of the latter approach can be attributed to the need for fewer facilities in comparison with the onsite control approach. (Baker-IVI)
W84-02364

4B. Groundwater Management

EFFECT OF A SUBSURFACE BARRIER ON THE CONSERVATION OF FRESHWATER IN COASTAL AQUIFERS,
Hydraulics Research Station, Wallingford (England).
H. O. Anwar.
Water Research, Vol. 17, No. 10, p 1257-1265, 1983. 7 Fig, 11 Ref.

Descriptors: *Groundwater barriers, *Saline water intrusion, *Coastal aquifers, Safe yield, Saline-freshwater interfaces, Upconing, Freshwater outflow, Groundwater movement, Model studies, Free surfaces.

It is of practical interest in many coastal aquifers to increase the safe yield by reducing the freshwater outflow to the sea and to prevent seawater intrusion into the aquifer. This may be achieved by partially embedding an impermeable subsurface barrier parallel to the coast into the aquifer. A theoretical and experimental study was undertaken to examine the effect of a barrier on the flow field. Considerations are restricted to steady flow in an isotropic aquifer. Shape factors describing the distribution of mass density and of the velocity are introduced and their values derived. From the laboratory model study using a vertical plane Hele-Shaw model the velocity shape factor was determined. It was approximately unity for flow without a barrier, and decreased when a barrier was introduced. The barrier depressed the interface considerably and the upconing started with a higher flow rate as compared with the case without a barrier. By introducing the concept of a virtual origin it is shown that the free surface does not approach the seepage face tangentially. This was also confirmed experimentally. (Moore-IVI)
W84-02179

ANALYSIS OF DUG-WELL TEST DATA,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W84-02207

FACTORS AFFECTING THE FLOW OF AFLAJ IN OMAN: A MODELLING STUDY,
Institute of Hydrology, Wallingford (England).
Y. P. Parks, and P. J. Smith.
Journal of Hydrology, Vol. 65, No. 4, p 293-312, September, 1983. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Water resources development, *Semiarid lands, Model studies, Drainage, Tunnels, Qanats, Aflaj, Oman, Water supply, Groundwater.

Shallow sloping drainage tunnels dug into the hillsides to intercept water tables are an important source of water supply in many semi-arid coun-

tries. Two major classes are qanats sited in extensive alluvial deposits and aflaj (singular falaj) in restricted wadi gravels. A digital model is presented which represents the physical processes involved in water movement in aflaj and qanat systems, based on a numerical discretization of the transient flow equations. The adequacy of the model has been assessed by comparing its solution with the observed response of a falaj situated in northern Oman. The falaj flow reaches exponentially for the conditions found in wadi gravels. Non-exponential recession only occurs immediately after recharge and when the water table is below the height of the active length of the falaj. The recession constant increases for increasing storage coefficient and wadi width whereas it decreases for increased permeability. Thus modelling falaj flow can provide similar information on aquifer characteristics as a pumping test conducted in the aquifer. The mechanism of recharge is most closely simulated by an areally even blanket-recharge. The model predicted Al Hamra falaj flow shows a close resemblance to the available data, although these data are not adequate for rigorous testing of the model applicability. The modelling method is particularly appropriate for use as part of water-resources management study. (Baker-IVI)
W84-02452

4D. Watershed Protection

SEDIMENTATION IN BURNED CHAPARRAL WATERSHEDS: IS EMERGENCY REVEGETATION JUSTIFIED,
San Diego State Univ., CA. Dept. of Biology.
C. R. Gautier.
Water Resources Bulletin, Vol. 19, No. 5, p 793-802, October, 1983. 6 Fig, 1 Tab, 42 Ref. NSF grant DEB-7913424.

Descriptors: *Watershed management, *Chaparral, *Revegetation, *Sediment erosion, *Fire effects, California, Land management, Floods, Sedimentation, Seeding.

One of southerns California's most serious land management problems is costly and destructive discharge of sediment form recently burned chaparral watersheds. Emergency revegetation has been practiced by State and Federal land management agencies for more than 25 years at considerable public expense. The purpose of the emergency revegetation practice is to reduce heavy sedimentation that takes place in recently burned chaparrel watersheds during infrequent flooding events. A general model of chaparrel watershed erosion and sedimentation process is presented, and the results of research on emergency revegetation are reviewed within the context of the model. Seeding has a limited potential for reducing sediment yields during floods. One weakness is that seeding rarely results in an increase in plant cover. A second and more serious weakness is that seeding has a negative impact on the recover of the native vegetation. By interfering with native vegetation recovery, seeding may lead to increased rather than decreased sediment yields. Seeding should not be used as a blanket treatment whenever sediment from a recently burned watershed threatens downstream improvements. (Moore-IVI)
W84-02169

EFFECT OF SUBSURFACE DRAINAGE ON RUNOFF AND SEDIMENT YIELD FROM AN AGRICULTURAL WATERSHED IN WESTERN OREGON, U.S.A.,
Oregon State Univ., Corvallis. Dept. of Soil Science.
J. D. Istok, and G. F. Kling.
Journal of Hydrology, Vol. 65, No. 4, p 279-281, September, 1983. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Subsurface drainage, *Erosion control, *Agricultural watersheds, *Sediment yield, *Oregon, Willamette Valley, Drainage, Runoff, Storm runoff.

Continuous measurements were taken for four winter rainfall seasons of rainfall, watershed runoff and suspended sediment concentrations for three small watersheds, 0.46, 1.4, and 6.0 ha in size. The watersheds were located on the hilly western margins of the Willamette Valley, Oregon, and were fall planted to winter wheat. A subsurface drainage system was installed on the 1.4 ha watershed following two rainfall seasons. The system consisted of a patterned arrangement of 10-cm plastic tubing at a depth of 1.0 m and a spacing of 12 m. After the system was operational, perched water tables were lowered and seepage was reduced. The reductions were quantified with a watertable index (cumulative integrated excess). Watershed runoff and sediment yield from this watershed were decreased by about 65 and about 55%, respectively. These reductions were estimated from double mass curves and by statistical regression on a set of hydrograph variables. Maximum flow and average flow rates were decreased and the time from the beginning of a storm to the peak flow increased. Subsurface drainage was therefore shown to be an effective management practice for controlling erosion in western Oregon. (Baker-IVI)
W84-02451

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

USE OF CLAMS AS BIOINDICATOR OF FECAL POLLUTION IN SEAWATER,
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
M. J. Al-Mossawi, MH. Kadri, and A. A. Salem.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 257-263, October 1983. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Clams, *Bioindicators, *Coliforms, *Salmonella, Coastal waters, Kuwait, Seawater, Circenita, Antibiotic resistance, Swimming, Water quality, Water pollution.

The coastal waters of Kuwait are widely used for bathing during the long summer season. In order to assess the water quality along the beaches, a new approach was developed. It involves the use of clam, Circenita callipyga, as a bioindicator for seawater pollution by fecal coliform bacteria (FC), antibiotic resistant fecal coliform (ABR-FC) and Salmonella spp. These organisms were detected in clam and water samples and the efficiency of clams in concentration Salmonella was confirmed. The number of FC and ABR-FC in clam and water samples were compared and a higher number was detected in clams than in water. Five isolates of Salmonella from clams were also multidrug resistant. The data suggests that clam can be used as a bioindicator of seawater pollution and is preferable to direct testing of water. The resistant to antibiotics in E. coli isolated from water and clams collected at the same time and site was of similar pattern and was determined by R-plasmid. (Author's abstract)
W84-02130

PROCEDURE FOR TESTING THE SENSITIVITY OF WATER BACTERIA TO SILVER IONS (TESTVERFAHREN ZUR PRUFUNG DER EMPFINDLICHKEIT VON WASSERKEIMEN GEGENUBER SILBER-IONEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
H.-C. Flemming, and H. Rentschler.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 157-160, 1983. 4 Tab, 33 Ref.

Descriptors: *Bacteria, *Silver nitrate, Aquatic bacteria, Silver sensitivity, Bactericides.

A simple procedure for testing the silver sensitivity of water bacteria is introduced. Silver nitrate solution in various concentrations is added to the water sample and the bacterial growth of the cultures is monitored over some days. It is important to avoid nutrients or agar, because they bind silver. The total population should be used for the test. The selecting effect of the silver ions causes an alternation in the microflora favoring those species that tolerate higher silver concentrations. This corresponds with observations on applying silver compounds in practice. Routined bacteriological monitoring is recommended when these compounds are put to practical use. (Author's abstract)
W84-02142

MASS TRANSFER MODEL TO DESCRIBE LEAD CONCENTRATIONS IN DRINKING WATER,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
A. Kuch, and I. Wagner.
Water Research, Vol. 17, No. 10, p 1303-1307, 1983. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Drinking water, *Lead, *Model studies, Mass transfer, Public health, Solubility, Pipes, Water quality.

Theoretical and practical work has been carried out on the dependence of lead solubility on water quality parameters. A mass transfer model is also presented to describe the dependence of lead concentrations on the type of drinking water supplied. Thus the amount of lead taken up by water in a lead pipe, under both stagnation and flowing conditions, can be calculated if the maximum equilibrium lead concentration and the geometry of the pipe are known. When more information of consumption patterns becomes available, it will be possible to estimate the mean lead uptake by drinking water for a typical household by calculation. The following data will be needed for every service pipe in order to successfully make decisions on priorities for pipe replacement: length and diameter of pipe, water consumption pattern in the house, number of adults and children in the house, maximum equilibrium lead concentration for the distributed water quality. Additional work on consumption patterns is necessary before any final recommendations on pipe replacement can be made. (Baker-IVI)
W84-02182

METHOD FOR CALCULATING EFFECTS, ON AQUATIC ORGANISMS, OF TIME VARYING CONCENTRATIONS,
Manhattan Coll., Bronx, NY.
J. L. Mancini.
Water Research, Vol. 17, No. 10, p 1355-1362, 1983. 13 Fig, 1 Tab, 15 Ref. EPA Cooperative Agreement 806828.

Descriptors: *Toxicity, *Aquatic animals, *Bioassay, Mortality, Water pollution effects.

A method is presented for calculation of the effects, on aquatic organisms, of exposure to time variable concentrations of toxicants. The technique employs data from classical bioassay tests obtained using constant toxicant concentrations. Calculations of organism mortality as a result of exposure to time varying concentrations are compared to observed data providing a test of the proposed method. The calculation procedure employs available data to assess the duration and extent of carry over effects from individual exposures. The proposed framework can be employed to calculate the probable mortality and the percentage of mortality stress anticipated from exposure to any time history of toxic concentrations. The framework assumes that the effects of an exposure, before death, are reversible. The effects of very high exposure concentrations for short durations may not always be reversible. The method allows utilization of the existing bioassay data base, both chronic and acute, to predict effects associated with time varying exposure concentrations. (Moore-IVI)
W84-02185

COMPARISON OF SEVERAL MICROBIOLOGICAL TOXICITY SCREENING TESTS,
National Water Research Inst., Burlington (Ontario).
B. J. Dutka, N. Nyholm, and J. Petersen.
Water Research, Vol. 17, No. 10, p 1363-1368, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Toxicity, *Bioindicators, Microorganisms, Dichlorophenol, Cetyl trimethyl ammonium chloride, Sodium lauryl sulfate, Phenol, Copper sulfate, Mercury chloride, Zinc sulfate, Microtox system, Spirillum volutans, Sludge.

Four short-term microbiological toxicity screening tests were compared using the following test chemicals: 3,5 dichlorophenol, cetyl trimethyl ammonium chloride, sodium lauryl sulfate, phenol, copper(II) sulfate, mercury(II) chloride and zinc(II) sulfate. These seven chemicals represent a wide range of toxicity. The methods examined were Beckman's Microtox system, the Spirillum volutans motility test, inhibition of respiratory activity of activated sludge, and inhibition of activated sludge TTC-dehydrogenase activity. The results obtained indicate that each method has its own toxicity sensitivity pattern, and among the substances tested, only mercury(II) chloride and phenol were ranked equally by the four methods as the most and the least toxic chemical, respectively. In a tentative ranking of the methods, according to sensitivity, the Microtox test came out as the most sensitive test, followed by the Spirillum test, which in turn appeared more sensitive than the two sludge tests. This ranking has meaning only in a statistical sense, however, and the variable nature of the results support the philosophy that for assessing toxicity more thoroughly, a battery of several tests is required. (Author's abstract)
W84-02186

FIELD INSTRUMENTATION FOR MONITORING WATER-QUALITY EFFECTS OF STORMWATER RUNOFF FROM HIGHWAYS,
For primary bibliographic entry see Field 6G.
W84-02228

TOXIC SUBSTANCE MONITORING IN THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
T. C. Wang.
Florida Scientist, Vol. 46, No. 3/4, p 286-295, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Chlorinated pesticides, *Polychlorinated biphenyls, *Pollutant identification, *Indian River Lagoon, Florida, Water pollution sources, DDT, Sediments, Malathion, Parathion, Hydrogen ion concentration, Water temperature, Salinity, Organic compounds.

Investigation of chlorinated pesticides and polychlorinated biphenyls (PCBs) in samples of water and sediment were made near sewage and power plant outfalls, freshwater tributaries, and agricultural runoff canals located along the Indian River between Vero Beach and St. Lucie Inlet (Florida). Chlorinated pesticide residues and PCB were not detected in surface water samples. Concentrations of several compounds such as DDT and PCB (Aroclor 1254) were low in sediment samples (<0.1 ppm), although they were detected at least once in most samples. The persistence of malathion and parathion decreased with increasing pH and salinity. When temperature was above 26 degrees C and salinity above 20 ppt, hydrolysis was the predominant pathway of degradation of malathion and biological interaction was the most significant pathway of degradation for parathion. Industrial chemicals such as trichloroethylene and other volatile organic compounds are currently being monitored in the Main Relief Canal and Indian River at Vero Beach. Background levels of trichloroethylene were low in both water and sediment samples (<0.1 ppb and approximately = 0.5 ppb, respectively). (Author's abstract)
W84-02251

SELECTION OF PRACTICAL INDICATOR SYSTEMS FOR MONITORING THE VIROLOGICAL QUALITY OF POTABLE WATER, WASTEWATER, SOLID WASTE, SHELLFISH, FISH AND CROPS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
P. V. Scarpino.
Water Science and Technology, Vol. 15, No. 5, p 17-32, 1983. 5 Tab, 69 Ref.

Descriptors: *Viruses, *Bioindicators, *Water analysis, *Wastewater analysis, Potable water, Indicators, Monitoring, Bacteria.

The actual detection of viruses or the use of an indicator system or systems to assess the presence of pathogenic viruses in contaminated environments is essential for the protection of human health. An ideal microbial indicator for assessment of viral presence should include the following properties: applicability in all types of environments, present whenever viral pathogens are present, have a reasonably longer survival time than the hardiest enteric viral pathogen, should not reproduce in the contaminated environment, and should be harmless. The possible surrogate relationships between pathogenic viruses and bacterial indicators of fecal pollution in the diverse environments of potable water, wastewater, solid waste, shellfish, fish and crops are considered. Assessments are made concerning the reliability of the indicator to identify in these diverse environments viral presence. Thus far no one has demonstrated a convincing relationship between the numbers and/or types of different indicator bacteria and the pathogenic viruses themselves. The search should continue for more acceptable alternatives which would eliminate the need for the more difficult and time consuming direct testing of pathogenic virus presence. the best indicator for pathogenic virus presence may be the virus itself. (Moore-IVI)
W84-02256

PUBLIC HEALTH, FINANCIAL AND PRACTICAL CONSIDERATIONS OF VIROLOGICAL MONITORING AND QUALITY LIMITS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
O. J. Sproul.
Water Science and Technology, Vol. 15, No. 5, p 33-41, 1983. 3 Tab, 27 Ref.

Descriptors: *Viruses, *Monitoring, *Water quality standards, Public health, Water treatment, Disinfection, Drinking water.

The recent literature on virus monitoring and virus standards for water are reviewed, and the information is extrapolated from field operating conditions. Virus standards appear to be in use or have been proposed in Arizona and Maryland in the United States, South Africa and the European Economic Community. There appears to be a minimal infective dose for each virus for a particular individual, but extrapolation of such a value to a large population is difficult. Costs of monitoring for viruses using present techniques are very high compared to coliform tests. If virus standards are established, then routine monitoring should be required to assure compliance with the standard. Extreme care must be taken in establishing virus standards since there is little documented evidence to support the conclusion that virus infections result from consuming an adequately treated water. Frequency of monitoring in drinking water should be established in accordance with the intent of the virus standard. The virus level which might be present in water from a modern, well-operated treatment plant may be so low that infections or diseases contracted from it are undetectable from the background contracted from other sources. It is important that monitoring and quality requirements be based on demonstrated facts. Such will assure an adequacy of water treatment but not in excess of that which is needed and which can be justified. The opposite is frequently counterproductive since the contempt which is bred for ill-advised regulations may result in lessening attention to other critical operational requirements. (Moore-IVI)
W84-02257

DEVELOPMENTS IN METHODS FOR THE DETECTION OF VIRUSES IN LARGE VOLUMES OF WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass.
Water Science and Technology, Vol. 15, No. 5, p 59-67, 1983. 40 Ref.

Descriptors: *Viruses, *Pollutant identification, Filtration, Membrane processes, Public health, Water quality control, Water analysis.

Recent developments in virus concentration methodology are reviewed. Evaluations of virus recovery by electronegative and electropositive membrane filters as well as other methods of virus concentration reported in recent literature are discussed. Many different techniques have been developed for virus concentration from water and these may be divided into those processes able to handle large volumes of water and those useful for smaller volumes. Membrane filtration is generally the most rapid and convenient for large volume field sampling. Electropositive filter media have been studied for virus recovery efficiency. Animal viruses have been concentrated from 19 liters of activated sludge effluent by Zeta plus 30S and MDS cartridge filters without modification of the water prior to filtration. Magnesium chloride has enhanced poliovirus adsorption to Filterite filters. Zeta plus 60S filters have been incorporated into a portable virus concentrator and tested in 500 liter samples of fresh water. Seitz filters were able to efficiently adsorb poliovirus from tap water at a pH range of 3.5 to 9.0. Positively charged chrysotile asbestos 47 mm filters concentrated poliovirus type 1 and coliphage f2 from 20 liters of tap water, pH 7.8 with average recovery efficiencies of 68% and 65%, respectively. A number of eluents have been compared for recovery of virus adsorbed to filters. Other virus concentration methods discussed include ultrafiltration, the Pellicon cassette recirculating flow molecular filtration system, the use of Talc-Celite, adsorption to a bed of iron oxide sandwiched between two filters, polyethylene glycol hydroextraction, organic flocculation, and aluminum hydroxide adsorption/precipitation. (Baker-IVI)
W84-02259

HUMAN ENTERIC VIRUSES ISOLATED FROM INFLUENTS OF SEWAGE TREATMENT PLANTS IN S. PAULO, BRAZIL,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
M. T. Martins, L. A. Soares, E. Marques, and A. G. Molina.
Water Science and Technology, Vol. 15, No. 5, p 69-73, 1983. 1 Tab, 33 Ref.

Descriptors: *Wastewater analysis, *Viruses, *Enteroviruses, *Sao Paulo, *Brazil, Poliovirus, Echoviruses, Coxsackie virus.

From April 1979 to May 1980, 55 sewage samples were collected from influents of a sewage treatment plant in Sao Paulo, Brazil which receives 12% of the total domestic sewage of Sao Paulo city. From the 55 sewage samples, 433 virus strains have been isolated, including 70.7% poliovirus, 19.2% echovirus, 7.6% coxsackievirus, and 2.5% untyped. Five different methods were used for virus recovery: adsorption to and elution from membrane filters; acidic precipitation; concentration through membrane filters, with reconcentration by organic flocculation; concentration on aluminum hydroxide; aluminum sulfate precipitation. The sewage sample was plaqued in bottle cultures on BS-C-1 cell line. This cell line allowed a recovery of 22 different serotypes of enteroviruses: the three poliovirus types, 14 types of echoviruses, four types of coxsackie B virus and one type of coxsackie A virus. The sewage examined receives contributions from areas of medium to high socioeconomic levels, and also from hospitals and industries. Massive oral vaccination against poliovirus is done yearly. This may explain the high percentage of poliovirus in these samples. (Moore-IVI)
W84-02260

VIRUS CONCENTRATION FROM WATER USING HIGH-RATE TANGENTIAL-FLOW HOLLOW FIBER ULTRAFILTRATION,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
D. M. Dziewulski, and G. Belfort.

Water Science and Technology, Vol. 15, No. 5, p 75-89, 1983. 5 Fig, 2 Tab, 20 Ref. NSF grant ENG-7826588.

Descriptors: *Virus concentration, *Ultrafiltration, *Water analysis, Poliovirus, Turbidity, Membrane processes.

The efficacy of tangential flow hollow fiber ultrafiltration (TFHFU) as a means of concentrating poliovirus 2 (Sabin) from large volumes of tap water was studied. Initially, hydrodynamic studies using 50-l tap water feed solutions were conducted to evaluate transmembrane flux as a function of axial flow rates (or Reynold's numbers, Re). With increasing Reynold's number, flux-decline rates were reduced. As a result, experimental duration was shortened from 110 min at Re=300 to 30 min at Re=1728. In all cases, radical flow was assisted by a vacuum force applied to the outside of the hollow fibers. Virus recovery capability was evaluated using 20-, 50- and 100-l feed samples seeded with poliovirus 2 from 604 to 0.5 pfu/ml. All virus experiments were conducted at Re=1728 and a vacuum force of 32,700 Pa. The mean duration of the 20-, 50-, and 100-l experiments was 13, 42, and 79 minutes, respectively. The overall average virus recovery from all experiments was 69.1 + or - 24.6%. In operating the tangential-flow hollow fiber ultrafiltration module in its normal recycle-mode with low turbidity waters (<20 NTU), the expected steady flux-decline resulting from membrane fouling was not observed. Instead, the transmembrane permeation flux was maintained at a relatively constant value especially near the end of the experiments when the solute concentration in the feed increased the fastest. Increased feed water temperature resulting from the addition of pumping energy during recycle is responsible for this unexpected advantage. Final temperatures never exceeded a point at which virus inactivation would occur. For high turbidity feed waters (75 to 85 NTU), obtained by the addition of kaolin clay, virus recoveries varied from 30 to 49%. Final turbidities at the termination of a 50-l run were from 950 to >1000 NTU. In spite of high turbidity, the mean experiment duration for dehyrating 50 liters of turbid feed water was 39 minutes; approximately the same as for the low-turbidity tap water runs. (Author's abstract)
W84-02261

STANDARD METHOD FOR QUANTIFICATION OF EARTHY-MUSTY ODORANTS IN WATER, SEDIMENTS, AND ALGAL CULTURES,
Metropolitan Water District of Southern California, La Verne, CA. Water Quality Branch.
S. W. Krasner, C. J. Hwang, and M. J. McGuire.
Water Science and Technology, Vol. 15, No. 6-7, p 127-138, 1983. 5 Fig, 7 Tab, 18 Ref.

Descriptors: *Odor, *Water analysis, *Sediments, *Algae, Closed-loop stripping analysis, Gas chromatography, Mass spectrometry, Earthy odor, Musty odor, Geosmin, Methyliosborneol, Taste.

Objectionable tastes and odors in drinking water are a common and widespread problem, with odors described as muddy or earthy-musty usually representing the most troublesome occurrences. Microbial metabolites from the microorganisms that exist in a drinking water system often are the cause of these problems. Closed-loop stripping analysis (CLSA), in combination with gas chromatography - mass spectrometry (GC/MS), has been used in the determination of five earthy-musty-smelling compounds (geosmin, 2-methylisoborneol, 2-isopropyl-3-methoxy pyrazine, 2-isobutyl-3-methoxy pyrazine, and 2,3,6-trichloroanisole). One-liter water samples are analyzed within 3 hours, with detection limits as low as 2 ng/l each. Precision and accuracy levels of 20% or better are obtainable with this method. This technique has been modified to include the CLSA of sediments and laboratory-grown microbiological cultures in order to investigate the sources of the odorous compounds. CLSA-GC/MS provides a valuable tool for extended surveys and regular monitoring of water supplies, and it is indispensable in the understanding and management of earthy-musty taste and odor problems. (Moore-IVI)
W84-02274

STRIPPING TECHNIQUES FOR THE ANALYSIS OF ODOUROUS COMPOUNDS IN DRINKING WATER,
Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Savenhed, H. Boren, A. Grimvall, and A. Tjeder.
Water Science and Technology, Vol. 15, No. 6-7, p 139-148, 1983. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Odor, *Water analysis, *Drinking water, *Stripping method, Gas chromatography, Mass spectrometry, Aldehydes, Ketones, Alcohols.

The closed loop stripping method was modified to improve the concentration of odorous compounds from drinking water. The main modification was the change from the closed loop to the open stripping system. The open stripping system has two advantages; the blank level is significantly lower and it is easier to use higher stripping temperatures. Sensory analysis of stripped waters and concentrates of stripped compounds under standard conditions (30 C, 2 hr) showed that the yield of odorous compounds increased substantially at elevated stripping temperatures and prolonged stripping times. Chemical analysis showed an increased recovery of semipolar compounds, e.g. aldehydes, ketones and alcohols. Raw and treated surface waters have been analysed. Capillary gas chromatography and mass spectrometry were used for the separation and identification. (Moore-IVI)
W84-02275

COMPARISON OF SORPTION AND EXTRACTION METHODS FOR RECOVERY OF TRACE ORGANICS FROM WATER,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
V. C. Blok, G. P. Slater, and E. M. Giblin.
Water Science and Technology, Vol. 15, No. 6-7, p 149-159, 1983. 1 Fig, 6 Tab, 33 Ref.

Descriptors: *Sorption, *Solvent extraction, *Water analysis, *Organic compounds, Adsorbents, Trace compounds.

Several commercially available adsorbents were compared with solvent extraction methods for their utility in recovering trace organics from water. The adsorbents examined included Amberlite XAD-2, XAD-4 and XAD-8, Ambersorb XE340 and XE348 and Tenax-GC. All were found to produce high artifact levels, even after extensive clean-up, making them unsuitable for the analysis of trace organics in water. Quantitatively, Likens-Nickerson (Am. Soc. Brewing Chem. Proc., 1964, 5-13) or continuous liquid-liquid extraction with methylene chloride gave better recoveries than the adsorbents. Qualitatively, extractive methods were preferred as they yielded much lower levels of impurities than the adsorbents. These methods of recovering trace organics were evaluated using a standard mixture of compounds added to the water at a level of 55 micro g/l. Likens-Nicherson extraction gave comparable recoveries of this mixture at 55 micro g/l and 11 micro g/l. (Author's abstract)
W84-02276

COMPOSITION OF FISH FILLETING WASTEWATER,
Centro de Investigaciones de Tecnologia Pesquera, Mar del Plata (Argentina).
J. F. Gonzales, E. M. Civit, and H. M. Lupin.
Water South Africa, Vol. 9, No. 2, p 49-56, April, 1983. 18 Fig, 5 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Food-processing wastes, *Effluents, Industrial wastes, Water pollution control, Seasonal variation, Phosphates, Nitrogen, Nitrate, Fisheries, Argentina.

Fish processing plants, particularly filleting, have developed in Argentina during the last few years. Wastewater from the plants in close proximity to urban areas is discharged to the sewer or harbor without treatment. The composition and seasonal variability of liquid effluents from hake filleting plants were studied as a first step in pollution control. Analyses for temperature, pH, settleable matter, total residue, grease and oil, phosphate, total Kjeldahl nitrogen, ammonia, nitrate, nitrite, BOD5 and COD were performed on 22 samples taken from June 1980 to May 1981. Data were statistically analysed. Operational policy appears to have a decisive influence on the composition of the wastewater. Moreover, seasonal variation, which could be correlated to raw material seasonal changes, was detected for grease and oil. (Baker-IVI)
W84-02304

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES; VII BUSHMANS, KARIEGA, KOWIE AND GREAT FISH RIVERS,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water South Africa, Vol. 9, No. 2, p 66-70, April, 1983. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Trace metals, *Estuaries, *South Africa, Bushmans River, Kariega River, Kowie River, Great Fish River, Sediments.

Surveys to study the distribution of selected metals in the Bushmans, Kariega, Kowie and Great Fish Rivers were carried out in the period August 1978-April 1979. Surface sediment and water samples and sediment cores were analysed for up to sixteen elements using atomic absorption spectroscopy. Interelement relationships as well as absolute metal concentrations were examined before interpreting the data obtained. Metal concentrations in sediment and water samples from the four rivers are normal for unpolluted Eastern Cape rivers and such conditions are likely to be maintained in the absence of further urbanization or industrialization. Relatively elevated metal levels were found at sites upstream from the river mouths but interelement ratios for these samples suggest that the metals are not anthropogenic but are derived from weathering of catchment rocks. Metal levels in sediment do not vary greatly with depth. (Baker-IVI)
W84-02306

APPLICATION OF A TETRAHYMENA PYRIFORMIS BIOASSAY SYSTEM FOR THE RAPID DETECTION OF TOXIC SUBSTANCES IN WASTEWATERS,
National Inst. for Water Research, Pretoria (South Africa).
J. L. Slabbert, R. Smith, and W. S. G. Morgan.
Water South Africa, Vol. 9, No. 3, p 81-87, July, 1983. 4 Fig, 7 Tab, 16 Ref.

Descriptors: *Monitoring, *Bioassay, *Wastewater analysis, *Toxicity, Effluents, Wastewater treatment, Tetrahymena, South Africa.

Decontamination of samples is a necessary step in the bioevaluation of heavily contaminated water samples in order to interpret toxic effects on oxygen uptake rate. A bioassay technique based upon the respiratory response of Tetrahymena pyriformis to intoxication was used to evaluate the quality of a number of effluents from three wastewater treatment plants in the Pretoria-Johannesburg area (South Africa). With this technique results are obtained within 10 min. Toxic activity was detected in both treated and untreated wastewater effluent. The technique was sufficiently sensitive to monitor toxicity in raw and treated wastewater effluent, and to evaluate the efficiency of the various treatment stages to remove toxicants from raw waters. A comparison of toxic effects with the concentration of individual chemical substances present after addition of the test samples to cell suspensions, showed the effects of wastewater effluents on respiration rates of the test organism could be attributed to the overall chemical activity rather than to the presence of individual toxicants. (Baker-IVI)
W84-02307

PRECIPITATE FLOTATION OF TRACE PHOSPHATE ION IN WATERS,
Tokyo Metropolitan Univ. (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.

Analytica Chimica Acta, Vol. 153, p 291-295, 1983. Fig, 2 Tab, 7 Ref.

Descriptors: *Pollutant identification, *Phosphates, Flotation, Natural waters, Spectrophotometry, Chemical precipitation.

A flotation-spectrophotometric method is described for the determination of soluble inorganic phosphate in freshwaters. Phosphate (5-150 micrograms/liter) in 1 liter samples is coprecipitated with aluminum hydroxide at pH 8.5. The precipitate is floated with the acid of sodium oleate and nitrogen, separated, and dissolved in 1M sulfuric acid. Phosphate is determined by a conventional method using molybdenum blue. Recoveries are better than 95% and the relative standard deviation is about 1%. The time required for the whole process is about 50 minutes for one sample. The method offers a rapid and precise means for the routine determination of phosphate in freshwaters. With suitable modification the procedure may also be applicable to sea water. (Baker-IVI)
W84-02379

COMPARISON OF METHODS FOR THE DETERMINATION OF LEAD IN POTABLE WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH LANTHANUM MATRIX MODIFICATION AND STANDARD ADDITION PROCEDURES,
South Staffordshire Waterworks Co., Walsall (England).
J. J. Fletcher.
Analytical Chimica Acta, Vol. 154, p 235-249, 1983. 7 Fig, 7 Tab, 17 Ref.

Descriptors: *Lead, *Water analysis, *Lanthanum matrix modification, *Potable water, Water quality, Pollutant identification, Atomic absorption spectroscopy.

The determination of lead by electrothermal atomic absorption spectrometry was investigated for 30 different borehole and surface water samples by using direct, standard addition and lanthanum matrix modification procedures. In the direct method, suppressive interference was evident for most samples. In some case suppression could be directly related to the constitution of the sample. Nitric acid and lanthanum (as the chloride or nitrate) were added to samples to overcome interferences in the direct determination. Source waters that exhibited severe suppression were used to optimize the concentrations of lanthanum and nitric acid (0.05% and 0.4%, respectively) required to effect full recovery of lead. The optimized procedure was evaluated during routine operation over a 6-month period with quality control samples and was shown to satisfy the required performance criteria for the determination of lead in potable waters. The method was superior to manual and automated standard addition procedures. (Author's abstract)
W84-02380

ENUMERATION OF THERMOTOLERANT COLIFORMS IN WATER USING DESOXYCHOLATE AGAR AT 43 DEGREES C,
Tokyo Univ. (Japan). Dept. of Food Science and Technology.
A. Hiraishi, K. Saheki, and S. Horie.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 8, p 1297, August, 1983. 1 Tab, 1 Ref.

Descriptors: *Coliforms, *Water quality control, Thermophilic bacteria, Bacteria, Tokyo, Wastewater, Sludge.

An attempt was made to use desoxycholate agar (DA) with incubation at 43 degrees C for the selective growth and enumeration of thermotolerant coliforms (TTC). The usefulness of the elevated temperature DA plate method for enumerating TTCs in different waters was evaluated. Water samples were collected from several points in Tokyo. Similar or higher average TTC counts were obtained from river water, estuary water, raw sewage, and activated sludge effluent samples by the elevated temperature DA plate method as compared to those estimated by the most probably number procedure. However, the former method gave a far lower average count than did the latter when examining mountain stream water samples. (Baker-IVI)
W84-02391

IDENTIFICATION AND DETERMINATION OF TRACE ORGANIC SUBSTANCES IN SEDIMENT CORES FROM THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst. Burlington, Ontario.
F. I. Onuska, A. Mudroch, and K. A. Terry.
Journal of Great Lakes Research, Vol. 9, No. 2, p 169-182, 1983. 13 Fig, 5 Tab, 14 Ref.

Descriptors: *Path of pollutants, *Organic compounds, *Lake Ontario, *Niagara River, *Sediment transport, Aromatic compounds, Dioxin, Alkylated benzenes, Phthalates, Esters, Olefins, Aldehydes, Chlorobenzenes, Benzoates.

Sediment cores were obtained at five sampling stations, and samples were extracted by the base/neutral and acid method designed by the EPA for extraction of water samples. The identification of organic compounds in the base/neutral sediment extract was carried out by GC/MS techniques. The major classes of investigated contaminants were aromatics, polynuclear aromatics, alkylated polynuclear aromatics, alkylated benzenes, phythalates, methylesters of fatty acids, olefins, aldehydes, chlorobenzenes, and benzoates. In addition, all sediment samples were analysed for 2,3,7,8-tetrachloro dibenzo-p-dioxin (TCDD) In the surface sediments, the abundance of contaminants decreased with the distance from the Niagara River mouth toward the north-west. High concentrations of most of the detected organics were present in sediment at the station located east of the river mouth. A measurable quantity of 2,3,7,8-TCDD equivalent was present in surface sediment (0 to 3-cm depth) at one station in the vicinity of the Niagara River mouth and in subsurface sediment at a station located east of the river mouth. Particle size distribution and geochemistry of the sediment were similar in al samples and were not responsible for the variations in concentration of individual organic compounds. Results indicate a major transport of organic pollutants toward the east of the Niagara River mouth; transport of sediment-associated pollutants exists to a small extent in the northwest direction from the river mouth. (Moore-IVI)
W84-02407

VOLATILE CONTAMINANTS IN THE WELLAND RIVER WATERSHED,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
For primary bibliographic entry see Field 5B.
W84-02415

CHLORINATED HYDROCARBONS IN THE SURFACE MICROLAYER OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
R. J. Maguire, K. W. Kuntz, and E. J. Hale.
Journal of Great Lakes Research, Vol. 9, No. 2, p 281-286, 1983. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Chlorinated hydrocarbons, *Surface microlayer, *Suspended solids, *Niagara River, Hepachlor epoxide, Endosulfan, Polychlorinated biphenyls, Dieldrin, BHC, Pesticides, Water pollution sources, Lake Ontario.

Concentrations of 18 chlorinated hydrocarbons were determined in the surface microlayer, subsurface water, and suspended solids at five stations along the length of the Niagara River in July 1981. The concentration of heptachlor epoxide in the unfiltered surface microlayer was greater than that in unfiltered subsurface water at all five stations by factors of 138 to 225; alpha-endosulfan and 'total PCB' were similarly enriched in the surface microlayer at two stations each, by factors of up to 203 and 32, respectively. In addition, mass balances for the 18 compounds in the three 'compartments' sampled showed that (i) at three stations there was more heptachlor epoxide in the unfiltered surface microlayer than associated with those suspended solids which were collected with a continuous flow separator from a depth of 1 to 2 m, and (ii) there was far more alpha- and gamma-BHC, dieldrin, and 'total PCB' present in unfiltered subsurface water than associated with the suspended solids. This latter finding in particular necessitates a revision of earlier estimates of loading of at least some chlorinated hydrocarbons to Lake Ontario from the Niagara River, based solely on concentrations in the suspended solids fraction sampled with the same continuous flow separator. (Author's abstract)
W84-02416

ORGANOCHLORINE CONTAMINANT RESIDUES IN SPOTTAIL SHINERS (NOTROPIS HUDSONIUS) FROM THE NIAGARA RIVER,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
K. Suns, G. R. Craig, G. Crawford, G. A. Rees, and H. Tosine.
Journal of Great Lakes Research, Vol. 9, No. 2, p 335-340, 1983. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Shiner, *Organochlorine compounds, *Pollutant identification, *Niagara River, Frenchmans Creek, Polychlorinated biphenyls, Mirex, Chlorinated benzenes, Octachlorostyrene, Dioxin, Pesticide residues, Cayuga Creek, New York, Lake Ontario, Water pollution sources.

Collections of young-of-the-year spottail shiners (Notropis hudsonius) were used to determine spatial distribution (1981) of organochlorine residues and their temporal trends in the Niagara River. PCB and mirex residues in spottail shiners ranged from 164 to 573 ng/g and non-detectable to 18 ng/g, respectively. PCB and mirex residues exceeded the aquatic life objectives (Great Lakes Water Quality Agreement of 1978) at all sites except Frenchman's Creek, where mirex was non-detectable. Residues for heptachlor, heptachlor epoxide, aldrin, endrin, chlordane, thiodan, dieldrin, BHC, and DDT were low or non-detectable in Niagara River spottail shiners. Chlorinated benzene and octachlorostyrene residues were also present in most Niagara River spottail samples analyzed. Dioxin (2,3,7,8-TCDD) was present in all Niagara River spottail shiner collections and ranged from 4 to 60 pg/g. The highest dioxin residues were found at Cayuga Creek, N.Y. PCB residues have declined significantly since 1975 in Niagara-on-the-Lake spottail shiners; however, residues increased in 1980 and 1981, although they were below the 1975 concentrations. Mirex residues in spottail shiners from Niagara-on-the-Lake have also declined significantly since 1978, suggesting reduced mirex inputs to Lake Ontario. (Author's abstract)
W84-02422

DETECTION OF PARTICLE-ASSOCIATED ENTEROVIRUSES FROM RAW AND TREATED SEWAGE AND LAKE MICHIGAN HARBOR WATER,
Wisconsin Univ.-Milwaukee, Dept. of Zoology/Microbiology.
L. E. Guskey.
Journal of Great Lakes Research, Vol. 9, No. 4, p 468-473, 1983. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Enteroviruses, *Suspended solids, *Wastewater analysis, *Water analysis, Viruses, Poliovirus, Chlorination, Particulate matter, Milwaukee Harbor, Wisconsin.

Suspended solids from raw sewage, various stages of wastewater treatment, and Milwaukee Harbor water were examined for associated enteroviruses. The solids were sedimented by centrifugation, and enteroviruses associated with them were eluted by homogenization in fetal bovine serum, analyzed quantitatively by plaque assay on Buffalo green monkey kidney cells, and identified by neutralization with Lim Benyesh-Melnick pooled antisera. Viruses were found at concentrations within approximately one order of magnitude in sediments from all samples. Nine different enteroviruses were

identified. All three types of poliovirus were detected in terminally treated (chlorinated) sewage, but the temperature-sensitive marker was not detected in the poliovirus strains isolated from chlorinated samples. Together these data indicate that exploitation of the association of viruses with suspended particles leads to a simple rapid means of monitoring virus distribution in sewage and natural waters. (Author's abstract)
W84-02430

5B. Sources Of Pollution

FATE OF METALS INTRODUCED INTO A NEW ENGLAND SALT MARSH,
Marine Biological Lab., Woods Hole, MA.
A. E. Giblin, I. Valiela, and J. M. Teal.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 81-98, July 1983. 8 Fig, 4 Tab, 40 Ref.

Descriptors: *Salt marshes, *Fertilizers, *Sludge, *Heavy metals, Fate of pollutants, Spartina, Crabs, Mussels, Sediments, Solubilization, Copper, Cadmium, Zinc, Iron, Manganese, Chromium, Lead, Great Sippewissett Marsh, Massachusetts.

As part of a study to investigate the effect of chronic eutrophication on salt marshes, a sewage sludge fertilizer has been applied to experimental plots in Great Sippewissett Marsh, MA, since 1974. The fertilizer contains substantial amounts of heavy metals. Sediments from fertilized plots contain elevated levels of Cu, Cd, Zn, Fe, Mn, Cr, and Pb. The above- and below-ground portions of the dominate grass, Spartina alterniflora, contain significantly higher levels of Cd, Cr, Cu, and Zn when compared to control plots. The mussel, Modiolus demissus, from fertilized plots contains elevated levels of Cu, Cd, and Cr. The fiddler crab, Uca pugnax contains more Cu and Cd than control animals. Low marsh sediments fertilized for 8 yr retained 15% Cd, 24% Fe, 27% Mn, 28% Zn, 45% Cr, 49% Cu, and 60% of the Pb in the fertilizer. Plots which had only received fertilizer for 1 yr retained a higher percentage of the metals which had been added. The differential solubilization of metals from the fertilizer appear to be one factor influencing metal retention on the plots although changes in sediment chemistry due to nutrient addition are also a factor. (Author's abstract)
W84-02129

ALUMINIUM CHEMISTRY AND ACIDIFICATION PROCESSES IN A SHALLOW PODZOL ON THE SWEDISH WESTCOAST,
Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
S. I. Nilsson, and B. Bergkvist.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 311-329, October 1983. 3 Fig, 5 Tab, 43 Ref.

Descriptors: *Soil solution, *Aluminum, *Acidification, Leachates, Soil chemistry, Water pollution sources, Groundwater, Streams, Podzols, Organic aluminum, Inorganic aluminum, Leachates, Lake Gardsjon, Sweden.

Soil acidification and the solution chemistry of Al were studied in three adjacent small catchments at Lake Gardsjon, on the Swedish westcoast, with mixed coniferous forest and shallow podzols (average soil depth 50 cm). Soil solution from different depths, groundwater and streamwater were sampled. Separation of organic and inorganic Al species was done with an ion exchange technique. The concentration of organic Al species was linearly correlated with the concentration of dissolved organic C (r2 varied from 0.38 to 0.69 with $p < 0.001$). In the A horizon 83 to 97% of the dissolved Al consisted of organic species. The average concentration of total Al varied from 3.3 to 9.8 micromole/l m soil leachates collected below the Ao horizon, and from 29.3 to 47.0 micromole/l in leachates collected below the A2 horizon. The organic Al species decreased in importance with increasing soil depth. Leachates collected below the B horizon had average total Al concentrations ranging from 95.3 to 115 micromole/l, with a contribution of organic species varying between 8 and 20% of the total concentration. Activity calculations indicated an equilibrium with Al(OH)SO4 (pKs = 17.23) in the lower part of the B horizon, while groundwater together with some of the leachates from the upper B horizon showed a better fit with Al4(OH)10SO4 (pKs = 117.51). Streamwater was obviously influenced by the soil organic matter in the outflow areas in terms of Al - organic matter complexes and protolysis of dissolved organic acids. There was a net outflow of Al and sulfate from the lower part of the B horizon compared to input in throughfall precipitation. The relative concentration increase varied from 64.4 to 78.0 (Al) and from 1.52 to 1.92 (sulfate). The relative increase due to evapotranspiration was estimated to be 1.4. The corresponding concentration factors for Mg and Ca were from 2.06 to 2.38, and from 0.81 to 1.07, respectively, indicating a very low Ca weathering. The study is part of the Gardsjo project, which deals with the mechanisms for groundwater and lakewater acidification and the direct and indirect consequences of the latter for the lake biota. The Al mobility is a central question, as inorganic Al forms are detrimental to some fish species. (Moore-IVI)
W84-02133

COMPARATIVE STUDIES OF RADIONUCLIDES FROM GLOBAL FALLOUT AND LOCAL SOURCES IN GROUND LEVEL AIR AND SEWAGE SLUDGE,
Lund Univ. (Sweden). Dept. of Nuclear Physics.
B. Erlandsson, T. Ingemansson, and S. Mattsson.
Water, Air, and Soil Pollution, Vol. 20, No. 3, p 331-346, 1983. 12 Fig, 5 Tab, 12 Ref.

Descriptors: *Cobalt radioisotopes, *Nuclear powerplants, *Fallout, *Air pollution, *Storm wastewater, Water pollution sources, Path of pollutants, Wastewater treatment, Dry deposition, Beryllium radioisotopes, Sweden.

Sampling of both sludge and ground level air was carried out at Borgeby sewage treatment plant, located 5.8 km east of the Swedish nuclear power station at Barseback, which is situated on the west coast of southern Sweden. The sewage treatment plant serves about 14,000 people in two communities; the daily incoming water volume is about 4200 cu m, and about half the total wastewater is rainfall runoff. The measured time variation of the Co-60 concentration in sludge and ground level air was found to be in good agreement with the reported variation in release rate to the air from the power station when the prevalent wind direction is taken into account. The ratio between the Be-7 normalized concentration in sludge and ground level air was studied and was found to be about 1 for radionuclides due to global fallout but less than 0.002 for Co-60. The low value for Co-60 may be explained by assuming that this radionuclide is dry deposited on the ground and then washed off by rain. The idea of dry deposition is supported by the wash-off pattern for Co-60 by rain after a drought period. Results strongly support the hypothesis that Co-60 and other activation products are released to the air from nuclear power stations. (Moore-IVI)
W84-02134

ROLE FOR SEDIMENTS IN RETARDING THE ACIDIFICATION OF HEADWATER LAKES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2H.
W84-02137

MERCURY POLLUTION OF FISHES IN MINAMATA BAY AND SURROUNDING WATER: ANALYSIS OF PATHWAY OF MERCURY,
Tokyo Univ. (Japan). Dept. of Chemical Engineering.
H. Nishimura, and M. Kumagai.
Water, Air, and Soil Pollution, Vol. 20, No. 4, p 401-411, November 1983. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Mercury, *Path of pollutants, *Fish, *Sediments, *Minamata Bay, Japan, Water pollution, Croaker, Zooplankton, Suspended solids, Particulate matter.

In 1973, an intensive survey of Hg pollution was made in Minamata Bay (Japan) and its surrounding water. Minamata Bay is estimated to have received about 260 t of Hg from an acetaldehyde plant which was in operation from 1932 through 1968. About 200 sediment samples and 1600 fish samples were collected for determination of Hg. The Hg level of a fish species and its local variation largely depended on the ecology of the species. The croaker was found to be a good indicator of Hg pollution of the sedentary fishes. The Hg level of a croaker showed a good correlation with the Hg level of sediment, but a better correlation was observed between the Hg content of croaker and that of zooplankton. A very close relationship was found between the Hg content of zooplankton and suspended particulate matter. A pathway of Hg from sediment to fish via suspended particulate matter and zooplankton was suggested. (Moore-IVI)
W84-02138

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF DETENTION BASINS,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
P. J. Wigington, Jr., C. W. Randall, and T. J. Grizzard.
Water Resources Bulletin, Vol. 19, No. 5, p 709-718, October, 1983. 8 Fig, 5 Tab, 19 Ref.

Descriptors: *Trace metals, *Detention reservoirs, *Storm runoff, *Soil contamination, Urban runoff, Cadmium, Copper, Lead, Zinc, Washington, District of Columbia.

Field investigations were conducted at three sites in the Washington, D.C., area to detect accumulation patterns of the trace metals, cadmium, copper, lead, and zinc in the soils of urban stormwater detention basins. The research results seemed to indicate that the use of detention basins to control urban stormwater runoff had few harmful effects to fine textured soils with respect to the study trace metals. Although the trace metals, especially lead and zinc, were found to accumulate in the surface soils of the basins, little significant downward movement of metals in the soil profiles had occurred. Accumulations of metals in the surface soils appeared to be a function of microtopography and the resultant residence time of standing water. The fractions of trace metals that were present in a leachable form in surface soils and stormwater solids were small, with median values ranging from 7.7% of the total concentration for Cd to 0.01% for Pb. (Author's abstract)
W84-02158

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: I. A CHARACTERIZATION,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 2L.
W84-02164

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: II. A METHOD FOR ASSESSING MINING IMPACTS,
Vermont Univ., Burlington. School of Natural Resources.
J. C. Clausen, and K. N. Brooks.
Water Resources Bulletin, Vol. 19, No. 5, p 769-772, October, 1983. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Peat, *Water pollution sources, *Peat mining, *Minnesota, Water temperature, Suspended sediments, Specific conductance, Acidity, Iron, Sodium, Nitrogen, Nonpoint pollution sources, Water quality.

The impacts of milled peat mining on runoff quality in northern Minnesota were determined using a multiple watershed approach. The milled peat mining operation requires clearing vegetation, ditching, raking, discing, and finally peat extraction with pneumatic harvesters. Coincident with sampling runoff quality from natural peatlands, samples were obtained from a ditch draining 155

ha of mined peatland. The frequency distributions of water quality constituents were used to detect whether runoff from a mined bog differed from that of 15 unmined (control) bogs. Peat mining increased water temperature, suspended sediment, specific conductance and concentrations of acidity, iron, sodium, and nitrogen species, although drinking water standards were not exceeded (alpha = 0.05). The multiple watershed method used enabled an evaluation of mining impacts without a long-term investment in streamflow monitoring. By incorporating several peatland watersheds into the study, a regional characterization of water quality constituents was obtained; comparisons between mined and unmined bogs were thus considered valid for the northern Minnesota region. (Moore-IVI)
W84-02165

SEDIMENT CHEMISTRY AS INFLUENCED BY VEGETATION AND BEDROCK IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
C. S. White, and J. R. Gosz.
Water Resources Bulletin, Vol. 19, No. 5, p 829-835, October, 1983. 5 Tab, 16 Ref.

Descriptors: *Sediments, *Vegetation, *Bedrock, Channel sediments, Sand, Silt, Clay, Organic matter, Minerals, Small watersheds.

It is hypothesized that sediment from small watersheds with uniform bedrock and a single vegetative community would have uniform chemical characteristics for the sand and fine (silt and clay) size fractions. Channel sediment was collected from three vegetative communities (spruce-fir, mixed conifer, and Ponderosa pine), each on four bedrock types (basalt, limestone, sandstone, and granite), and analyzed for digestable Ca, Mg, Na, K, Cu, Mn, Fe, Zn; total N and P; extractable Ca, Mg, K; cation exchange capacity; and organic matter. With the exception of organic matter content in the sand size fraction, either vegetation, bedrock, or their interaction were significant in explaining the observed variation for all analyses in both size fractions. Replicate studies of sites with similar bedrock and vegetation combinations are needed to determine if each watershed has similar or unique sediment chemistry. (Authop's abstract)
W84-02173

FACTORS AFFECTING THE CONCENTRATIONS OF CADMIUM, ZINC, COPPER AND LEAD IN THE SEDIMENTS OF THE VESDRE RIVER,
Liege Univ. (Belgium). Dept. of Botany.
C. Houba, J. Remacle, D. Dubois, and J. Thorez.
Water Research, Vol. 17, No. 10, p 1281-1286, 1983. 2 Fig, 5 Tab, 24 Ref.

Descriptors: *Sediments, *Heavy metals, *Vesdre River, Belgium, Zinc, Cadmium, Copper, Lead, Clay, Silt, Water pollution, Mining, Industrial wastes, Iron hydroxide, Phosphates.

The main factors influencing Cd, Zn, Cu and Pb concentrations in the sediments of the highly polluted Vesdre River (eastern Belgium) have been investigated. The concentrations of heavy metals in the tributaries were taken as a base reference. The reference levels are high due to past zinc mining activities in the area and the occurrence of zinc-enriched ores near the source of the river. The concentrations of the same elements are 5-10 times higher in the Vesdre, especially downstream from a former zinc factory. Only negative correlations were demonstrated between the clay content and heavy metals. The composition of the clay minerals could partially explain this paradox. The highest proportion of clay in the Vesdre is only 4% and it contains no smectite. The predominant clay component, illite, has a very low cation exchange capacity. Due to the small proportion of clay, the fraction of the sediment smaller than 14 microns is mainly composed of silt whose cation exchange capacity is negligible. The pretreatment of the minerals might influence the geochemical data obtained from analysis. Iron-hydroxides and phosphates seem to be the main sinks for Pb, Cd and Zn whereas organic components might play a less important role. (Moore-IVI)
W84-02180

TRANSPORT OF 14C-LABELLED PCB COMPOUNDS FROM SEDIMENT TO WATER AND FROM WATER TO AIR IN LABORATORY MODEL SYSTEMS,
Lund Univ. (Sweden). Limnological Inst.
P. Larsson.
Water Research, Vol. 17, No. 10, p 1317-1326, 1983. 10 Fig, 3 Tab, 34 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Sediments, Invertebrates, Pollutant transport, Model studies, Bubbles, Jet drops, Aquatic environment, Bioturbation, Bioaccumulation, Chironomids. Tubificids, Tetrachlorobiphenyl, Hexachlolobiphenyl, Octachlorobiphenyl.

Tetra-, hexa- and octachlorobiphenyls were added to aquatic model systems compound of undisturbed sediment cores with an overlying water phase. Using impactor plates transport of the compounds from sediment to air was observed. About one per cent of the sediment-bound PCBs recovered in the systems left the water by jet drops from bursting bubbles. The transport of PCBs from the sediment to the air was nearly constant over time, with a transport rate of 0.62 micro g/sq dm/week for tetrachlorobiphenyl. Tetrachlorobiphenyl was mobile in systems with and without macroinvertebrates and in those fixed with HgCl2. Hexa- and octachlorobiphenyls were transported from sediment to water mainly by bioturbation processes. The two latter substances had a higher adsorption to particles than tetrachlorobiphenyl. Compared to tetrachlorobiphenyl, more hexa- and octachlorobiphenyls accumulated in chironomids and tubificids. (Author's abstract)
W84-02183

ROTAVIRUS AND REOVIRUS STABILITY IN MICROORGANISM-FREE DISTILLED AND WASTEWATERS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
A. E. McDaniels, K. W. Cochran, J. J. Gannon, and G. W. Williams.
Water Research, Vol. 17, No. 10, p 1349-1353, 1983. 4 Fig, 2 Tab, 30 Ref. OWRT project B-054-MICH.

Descriptors: *Rotavirus, *Reovirus, *Virus survival, Distilled water, Wastewater, Water temperature, Infectivity, Viruses.

Survival of calf rotarvirus and reovirus under controlled laboratory conditions in microorganism-free, distilled and wastewater at 8 and 26 degrees C was examined by periodic measurement of cytopathic effects (CPE) and indirect fluorescent antibody (IFA) assays. Five samples of both water-types were collected and inoculated with the two viruses. Three samples of each type of water were divided into two bottles, one per virus, for incubation at 8 degrees C. Two samples were used at 26 degrees C one per trial. In the absence of light and shaking at 26 degrees C, 7-13 days were required for a loss of 90% infectivity for rotavirus and reovirus, while at 8 degrees C, averages were 80 days for rotavirus and 260 days for reovirus. Virus infectivity remained for more than 30 days at 26 degrees C and 400 days at 8 degrees C. Rates of decline were 10-100 times greater at 26 than at 8 degrees C, but at both temperatures, the MPN log 10 rate of decline of infectivity was linear. (Author's abstract)
W84-02184

SORPTION OF HYDROPHOBIC COMPOUNDS BY SEDIMENTS, SOILS, AND SUSPENDED SOLIDS - I; THEORY AND BACKGROUND,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
T. C. Voice, and W. J. Weber, Jr.
Water Research, Vol. 17, No. 10, p 1433-1441, 1983. 3 Fig, 59 Ref.

Descriptors: *Fate of pollutants, *Sorption, Soils, Suspended solids, Sediments, Hazardous wastes, Transport, Hydrophobic compounds, Organic carbon, Partition coefficient.

The current level of understanding of sorption processes relative to hydrophobic compounds in aquatic systems is reviewed. Particular emphasis is given to the details of sorption theory and to the extent to which it can be applied to the adsorption of hydrophobic pollutants by sediments, soils, and suspended solids. Hydrophobic bondng, an entropically driven dissolution reaction, is a major sorption mechanism. A universal sorption model has yet to be found and data must be treated on a case-by-case method. Total organic carbon content appears to be the major factor in determining a solid's sorptive potential. The octanol-water partition coefficient is the best known indicator of the extent to which a compound will sorb. Sorption reactions of hydrophobic compounds are generally rapid. (Baker-IVI)
W84-02194

SORPTION OF HYDROPHOBIC COMPOUNDS BY SEDIMENTS, SOILS AND SUSPENDED SOLIDS - II; SORBENT EVALUATION STUDIES,
W. J. Weber, Jr., T. C. Voice, M. Pirbazari, G. E. Hunt, and D. M. Ulanoff.
Water Research, Vol. 17, No. 10, p 1443-1452, 1983. 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Fate of pollutants, *Sorption, Soils, Suspended solids, Sediments, Hazardous wastes, Transport, Hydrophobic compounds, Polychlorinated biphenyls, Microorganisms, Model studies, Partition coefficient.

Sorptive interactions of pollutants with sediments and suspended solids in natural aquatic systems were investigated. The interpretation of these data vis-a-vis published data for other systems suggests that certain conclusions particularly those drawn from pesticide/soil systems, can be extended to hydrophobic pollutants in aquatic environments. The organic carbon content of a solid appears to be the major factor in determining its sorptive capacity. Other properties of both the solid and the system in which it is dispersed, especially the concentration of a sorbing pollutant, are important as well. Assumptions of linear partitioning, commonly made in the descriptive modeling of sorption reactions in aquatic systems, should be used with extreme caution, and only after substantiation for the specific sorbate/sorbent combination and concentration range in question. The concentration of solids appears to affect linear partition coefficients in a manner consistent with the Freundlich model. Sorption reactions between hydrophobic pollutants and sediments or suspended solids in aqueous systems are rapid and probably not rate-limited. (Baker-IVI)
W84-02195

EFFECT OF SUBSOIL CONDUCTIVITY AND THICKNESS ON INTERFLOW PATHWAYS, RATES AND SOURCE AREAS FOR CHEMICALS IN A SLOPING LAYERED SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W84-02208

CONCEPTUALIZATION OF A MODEL FOR THE MOVEMENT OF POLLUTION IN AN AQUIFER - APPLICATION TO THE RHINE GRABEN (CONCEPTION D'UN MODELE DE PROPAGATION DE POLLUTION EN NAPPE AQUIFERE - EXEMPLE D'APPLICATION A LA NAPPE DU RHIN),
Bureau de Recherches Geologiques et Minieres, Strasbourg (France). Service Geologique Regional Alsace.
P. Vigouroux, J. P. Vancon, and C. Drogue.
Journal of Hydrology, Vol. 64, No. 1/4, p 267-279, July, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Aquifers, *Fate of pollutants, Retention, Convection, Dispersion, Rhine Graben, France, Industrial wastes, Chlorides, Sulfates, Waste dumps, Leachates, Model studies.

A model is presented for the spreading of pollutants in aquifers, taking into account convection, dispersion and retention. This two-dimensional plane model uses values of concentrations averaged over a vertical axis; it is written in FORTRAN IV. It had been used to study some existing cases of pollution in the aquifer of the Rhine Graben, which is one of the most extensive in Europe (170 km x 30 km). The role of different parameters governing the spreading of pollution is described by the model. Over large distances, retention has a dominant influence. Dispersion mainly affects the displacement of concentration peaks over short distances, but becomes less important at greater distances from the source. The example considered refers to pollution by soluble salts (chlorides and sulfates) which were leached from industrial waste dumps. The hydrodynamic dispersion model has been verified for a period of about 30 years. The slight deviations between observations and model results are probably due to the effects of gravity, which were neglected in the model. The model shows also the effects of countermeasures which were taken to prevent future spreading of pollutants. (Baker-IVI)
W84-02212

QUALITY OF SEEPAGE AND LEACHATE FROM MINE AND MILL WASTES AND CONTROL OF ITS EFFECTS,
D. van Zyl, T. A. Shepherd, and A. C. S. Smith.
Transportation Research Records, No. 892, p 8-12, 1983. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Mine wastes, *Water pollution control, Detergents, Seepage, Highways, Construction, Leachates, Environmental effects, Acid mine drainage.

Mine and mill wastes, such as waste rock and tailings, are possible sources of road construction material. However, although such materials may be suitable from geotechnical considerations, they may prove to be problematic as they may produce contaminated seepage and leachate. A classification is presented of the types of mine and mill waste. Three important considerations in the use of these mine wastes are (a) the origin and characteristics of the waste rock; (b) the influence of mineral extraction process on leachate quality from tailings (typical problems associated with the various waste types are highlighted); and (c) changes in soil structure due to leachate, e.g., the Na ion, which can accelerate weathering or lead to changes due to ion exchange. Leachate from mine waste can have detrimental effects on the environmental due to effluent quality. It can also influence the integrity of engineering structures through chemical attack in many forms. The detrimental effects of leachate from mine waste can be controlled by treatment before placement, treatment during placement, treatment of effluent, and other methods, e.g., the use of detergents to inhibit bacterial activity in the formation of acid drainage. (Author's abstract)
W84-02217

SURVEY OF TECHNIQUES USED FOR PREDICTING LEACHATE QUALITY,
J. C. Wright, Jr., and S. S. Iyengar.
Transportation Research Record, No. 892, p 20-25, 1983. 4 Tab, 17 Ref.

Descriptors: *Leachates, *Testing procedures, Fate of pollutants, Acidity, Sulfur, Fill materials, Waste disposal.

Prediction of waste or fill leachate quality is often an important consideration, as it can be used in determining material placement, drainage designs, leachate containment (clay liner), or surrounding material interaction evaluations and identifying potential impacts to hydrologic regimes, ecological systems, or treatment requirements. In addition, leachate characteristics are often used to classify materials (e.g., hazardous wastes or acid-producing overburden or fill). There are several leachate evaluation test methods, which range from predicting the potential presence of selected characteristics within possible leachates to actual leachate quality determinations of representative materials by using representative leachate fluids. Because cost and time requirements vary with each leachate prediction test, the test method chosen to evaluate a material's potential leachate quality should be based on information requirements of the investigation. Several nonleaching, batch, and column leaching tests were examined as to information that can be obtained from these leachate prediction techniques. Several of these leachate quality prediction techniques, which included reaction pH, total sulfur, acid-base accounting, American Society of Testing and Materials 1:4 shake extraction of solid waste with water, U.S. Environmental Protection Agency extraction procedure toxicity test, and periodic column leaching tests, were then applied to several waste materials. The resulting test data were then compared. The application and usefulness of the various testing procedures in predicting leachate quality of inorganic parameters are discussed. (Author's abstract)
W84-02218

IDENTIFICATION OF SOURCE MATERIALS FOR ACID LEACHATES IN MARYLAND COASTAL PLAIN,
D. P. Wagner, D. S. Fanning, and J. E. Foss.
Transportation Research Record, No. 892, p 25-28, 1983. 3 Tab, 17 Ref.

Descriptors: *Leachates, *Coastal plains, Sulfuric acid, Acidity, Oxidation, Sediments, Pyrite, Chemical reactions, Maryland, Weathering, Minerals, Sulfates, Excavation, Construction.

The generation of excessive amounts of sulfuric acid often becomes a severe problem when excavation activities cause the exposure of sulfide-bearing rocks and sediments to the oxidizing atmosphere. Because of the hazards these sediments pose to building materials and ecosystems when exposed to the atmosphere by excavation, identification of sulfidic strata is an important first step in the course of construction activities to avoid or control acid sulfate problems. Acid leachates are produced in the oxidation of naturally occurring, sulfide-bearing sediments distributed throughout much of the Maryland Coastal Plain. Geologic ages for the sediments span from Lower Cretaceous through Tertiary. When these sediments are exposed to the atmosphere, sulfuric acid is produced in quantities sufficient to prohibit plant growth, dissolve concrete, and corrode metal. Initial pH values of near neutral or above may drop to as low as 2 after the sulfidic sediments undergo oxidation. In addition to pH, characteristics useful in identifying sulfide-bearing Coastal Plain sediments include sulfur content, sediment morphology, presence of sulfide or sulfate minerals, and morphology of surface soils formed from the sediments. Unoxidized sulfidic sediments are mostly dark colored. Typical colors include black (5Y 2.5/1), gray (10YR 5/1), or dark gray (5Y 2/1). Pyrite has been identified as the principal sulfide mineral present in the sediments. Pyrite morphology ranges from large megascopic crystals associated with Lower Cretaceous lignitic deposits to microscopic framboids common in Upper Cretaceous and Tertiary formations. Sulfate minerals formed from pyrite oxidation are useful field indicators of acid-generating sediments. Sulfate minerals that have been identified in acidic sediments include rozenite, szomolnokite, ferrohexahydrite, copiapite, gypsum, and jarosite. Jarosite is a highly persistent mineral and has often been observed in naturally weathershed soil profiles formed from sulfide-bearing sediments. The identification of jarosite in near-surface soil horizons thus may serve as an indication of underlying sediments with acid-generating potential. (Baker-IVI)
W84-02219

LEACHATES FROM EXCAVATIONS AND FILLS: SUMMATION,
J. G. Laguros, and L. W. Canter.
Transportation Research Record, Vol. 892, p 28-33, 1983. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Leachates, *Water pollution sources, Sediment transport, Sedimentation, Ammonia, Environmental effects, Groundwater pollution.

Five papers presented at the Symposium on Leachates from Highway Fills and Cuts are summarized. The papers deal with source characterization, leachate testing both in quality and in quantity and rate-determining factors, environmental transport, environmenttal effects and evaluation thereof, and control and abatement of leachates. Present data indicates that leachate quality and quantity is a problem of great concern. Although the undesirable effects of leachates on surface watercourses have been studied adequately, the data on groundwater quality are minimal. Sources of leachates have been well identified and there is continuing, if not increasing, interest in this area. However, leachage control data lag very much behind source data. Field oriented studies on a broad scale should be initiated to identify leachate control methods. The studies on rate-determining factors for nearly all phases of leachate effects appear to have not reached a level that offer dependable design values. (Baker-IVI)
W84-02220

MANAGEMENT OF DRAINAGE SYSTEMS FROM HIGHWAY BRIDGES FOR POLLUTION CONTROL,
Y. A. Yousef, M. P. Wanielista, H. H. Harper, and J. E. Christopher.
Transportation Research Record, No. 896, p 51-55, 1983. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Highway effects, *Bridges, *Runoff, Cadmium, Heavy metals, Lead, Zinc, Copper, Chromium, Iron, Nickel, Drains, Sediments, Floodplains, Drainage systems, Lake Ivanhoe, Orlando, Florida.

Pollutants associated with runoff water from highway bridges were characterized and quantified. These pollutants are directly discharged through scupper drains to adjacent water bodies and floodplains or detained in ponds before being released to lakes and streams. Selected heavy metals, such as lead, zinc, copper, chromium, iron, nickel, and cadmium, were of particular concern because of their potential enrichment in biota. Results show significant differences in heavy metal concentrations between water samples from bridge runoff and adjacent streams. Heavy metals tend to concentrate in bottom sediments, floodplains, and adjacent soils. For example, bottom sediment samples from Lake Ivanhoe, north of Orlando, Florida, collected beneath bridges with scupper drains showed significantly higher concentrations of heavy metals than did samples collected beneath bridges without scupper drains. In addition, concentration of heavy metals in the sediments of detention ponds receiving bridge drainage were higher than concentrations in sediments from adjacent lakes. It appears that management and careful design consideration of highway bridge drainage systems could result in significant reduction of the amount of pollutants released to adjacent water bodies. (Author's abstract)
W84-02227

VERIFYING THE EFFECT OF ACID PRECIPITATION ON SOIL LEACHATES: A COMPARISON BETWEEN PUBLISHED RECORDS AND MODEL PREDICTIONS,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
P. A. Arp, and S. Ramnarine.
Ecological Modelling, Vol. 19, No. 2, p 119-138, June, 1983. 1 Fig, 8 Tab, 19 Ref.

Descriptors: *Acid precipitation, *Soil chemistry, *Leaching, Model studies, Soil water, Groundwater, Water quality, Aluminum, Iron, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium, Cations.

A model for predicting the effects of acid precipitation on the acid ($H(+) + Al(3+) + Fe(3+)$)- and base ($Na(+)$ $K(+) + Ca(2+) + Mg(2+)$)-cation losses from soil via leaching as function of

time was verified by examining published results for one indoor and five outdoor lysimeter studies (with precipitation pH-values ranging from 2 to 6), and five watershed studies. In each case the prediction of the model were in acceptable (but not perfect) agreement with the observed acid and base cation losses. These studies were selected from other relevant studies because they nearly met the information requirements of the model. The prediction of the acid cation content of soil leachates is important for considering the generally negative effects of such cations (especially the dominating Al(3+)-ions) on plant growth and ground-, stream- and later water quality. (Author's abstract)
W84-02238

MODELLING THE EFFECTS OF ACID PRECIPITATION ON SOIL LEACHATES: A SIMPLE APPROACH,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
P. A. Arp.
Ecological Modeling, Vol. 19, No. 2, p 105-117, June, 1983. 1 Fig, 17 Ref.

Descriptors: *Acid precipitation, *Soil chemistry, *Leaching, Acidification, Model studies, Water pollution sources, Hydrogen ion concentration, Iron, Aluminum, Sodium, Potassium, Magnesium, Calcium, Cations.

A model is proposed to provide a simple, yet quantitatively valid perspective for the extent of soil (and lake) acidification to be expected for chemically and biologically active soils under the threat of acid precipitation. The model attempts to predict the acid (H(+) + Al(3+) + Fe(3+)) and base (Na(+) + K(+) + Mg(2+) + Ca(2+)) cation losses from the soil, calculated from the rate and amount of acid cation retention when the rate of acid cation input is constant. It is assumed that the total amount of acidity retained by the soil is limited and qualitatively follows a Freundlich-type 'absorption' isotherm. Required input information for the model includes (i) the total amounts of acid and base cations received by the soil via precipitation and weathering (minus normal leaching losses), (ii) the exchangeable base cation content and total number of cation exchange sites of the soil prior to the onset of acid precipitation. (Author's abstract)
W84-02239

NITRIFICATION MODEL WITH AN INHIBITORY EFFECT OF SEA WATER,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
For primary bibliographic entry see Field 2L.
W84-02241

TOXIC SUBSTANCE MONITORING IN THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
For primary bibliographic entry see Field 5A.
W84-02251

TRACE METALS IN THE INDIAN RIVER LAGOON, FLORIDA: THE COPPER STORY,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
J. H. Trefry, M. Sadoughi, M. D. Sullivan, J. S. Steward, and S. Barber.
Florida Scientist, Vol. 46, No. 3/4, p 415-427, 1983. 6 Fig, 1 Tab, 19 Ref. Florida Sea Grant College grant 04-8-MO1-76.

Descriptors: *Copper, *Water pollution sources, *Indian River Lagoon, Florida, Eau Gallie Harbor, Indian River, Trace metals, Anti-fouling paint, Sediments, Barnacles, Clams, Crabs, Leaching, Fate of pollutants.

Inputs of copper from anti-fouling paints presently pose an environmental stress on some restricted embayments of the Indian River Lagoon, Florida. Over an 18 month period, samples of water, suspended matter, sediments, barnacles, clams and crabs from selected sites along the Indian River and the Eau Gallie River, have been analyzed for copper. Higher than normal copper concentrations were consistently observed in the water column, sediments, barnacles and crabs collected from the Eau Gallie Harbor. Point sources of copper could be directly traced to vessel-related activities. From field data and laboratory experiments on the leaching of copper from anti-fouling paints, an estimated flux of 40 kg/yr to Eau Gallie Harbor was calculated. Up to 75% of the total copper input to the harbor may be retained there. Outside such tributaries along the Indian River from Vero Beach to Melbourne, copper levels were within normal limits. (Author's abstract)
W84-02253

DISTRIBUTION OF ENTERIC VIRUSES AND MICROORGANISMS IN LONG-TERM SEWAGE-TREATED SOIL,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
Z. Filip, K. Seidel, and H. Dizer.
Water Science and Technology, Vol. 15, No. 5, p 129-135, 1983. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater irrigation, *Land disposal, *Microorganisms, *Enteroviruses, Groundwater pollution, Viruses, Soil contamination, Bacteria, Actinomycetes, West Berlin, West Germany.

To determine whether long-term sewage treatment can take place without a pollution risk for soil and groundwater, samples from sewage irrigation fields in West Berlin (West Germany) which have been in use since about 1890 were analyzed for enteric viruses and microorganisms. Enteric viruses were detected in only seven samples from a total number of eighty seven taken from different soil depths. With only one exception, no viruses were found below 60 cm. No viruses were detected in groundwater samples. Long-term sewage irrigation did not result in significant changes in the colony counts of aerobic soil bacteria, but the counts of anaerobic bacteria and actinomycetes were slightly elevated and those of microscopic fungi slightly decreased. Potentially pathogenic bacteria were not detected in soil below 90 cm. (Author's abstract)
W84-02264

POTENTIAL OFF-FLAVOUR COMPOUNDS FROM CHLOROBLEACHING OF PULP AND CHLORODISINFECTION OF WATER,
Jyvaskyla Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, J. Knuutinen, J. Tarhanen, T. Kuokkanen, and K. Surma-Aho.
Water Science and Technology, Vol. 15, No. 6-7, p 97-104, 1983. 2 Fig, 1 Tab, 26 Ref.

Descriptors: *Bleaching wastes, *Chlorination, *Taste, Water pollution sources, Pulp wastes, Fish, Chlorinated hydrocarbons, Phenols, Anisols, Aldehydes, Ketones, Finland.

Persistent chlorinated organic acids, phenols, and neutral compounds formed in chlorination processes and discharged to the aquatic environment are one source of tainting of fish below pulp bleaching and water chlorodisinfection plants. Microbial metabolism of the chlorobleaching residues can produce additional off-flavor causing compounds. The model compound approach employed revealed the structures and amounts of pollutants formed and has made the interpretation and assay of individual organochlorine compounds in the environment possible. Tainting of fish near chlorination plants is frequently observed. Chlorinated phenols and anisoles (microbial metabolites of the former) are chlorination products which are known to have a strong odor and taste at very low concentrations. Other chlorinated products, which are potential tainting substances, e.g. halogenated hydrocarbons, acids, aldehydes and ketones were also studied. Contents of some organochlorine pollutants in pikes of Middle Finland were compared by the taste panel evaluation of the same fish samples. (Moore-IVI)
W84-02272

VOLATILE SUBSTANCES FROM ACTINOMYCETES: THEIR ROLE IN THE ODOR POLLUTION OF WATER,
Rutgers - The State Univ., Piscataway, NJ. Waksman Inst. of Microbiology.
N. N. Gerber.
Water Science and Technology, Vol. 15, No. 6-7, p 115-125, 1983. 10 Fig, 43 Ref.

Descriptors: *Odor control, *Actinomycetes, Organic compounds, Volatility, Water quality control, Geosmin, Methylisoborneol, Isopropylmethoxypyrazine.

The isolation, structure proof and chemical synthesis of three volatile, highly odorous metabolites of actinomycetes are presented as well as their relation to odor problems in natural waters. The three include geosmin, methylisoborneol and 2-isopropyl-3-methoxy pyrazine. Other volatile but less odorous metabolites of actinomycetes including mucidone are mentioned. The role of actinomycetes in the odor pollution of natural aters, fish and other items of commerce such as milk, cacao beans, tobacco and wine has been long known. Of the three major actinomycetic odorants studied the pyrazine has absorption in the UV range which means that it might be determined easily by high pressure liquid chromotography. The maxima are 275 nm at neutrality and 295 nm under slightly acid conditions. (Baker-IVI)
W84-02273

MEASURES TO PREVENT WATER POLLUTION BY CHEMICAL FERTILIZERS AND SOIL EROSION PRODUCTS,
P. S. Pasternak, N. N. Prikhod'ko, V. P. Landin, and Yu. D. Matukhno.
Water Resources, Vol. 9, No. 4, p 409-415, July-August, 1982. 6 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 128-135, July-August, 1982.

Descriptors: *Groundwater pollution, *Fertilizers, *Erosion control, Organic compounds, Urea, Ammonium nitrate, Superphosphate, Manure, Nitrophoska, Phosphorus, Potassium, Reforestation, Water pollution control.

Part of the fertilizers applied to croplands enters water bodies with the surface and subsurface runoff and affects the chemical composition and quality of natural waters. Modern agricultural techniques have become one of the greatest contributors of biogenic elements (BE) to the water system. A study of the effect of various forms and rates of chemical fertilizers on the quality of surface runoff from croplands was carried out in model experiments with sugar beets set up on runoff plots with fourfold replication. The most common fertilizers used were studied including ammonium nitrate, urea, granulated superphosphate, manure salts, and nitrophoska at rates of 60, 90, and 180 ka/ha of the active ingredient. Fertilizers were applied in the spring during topdressing of the crops. An additional 30 kg/ha each of phosphorus and potassium were applied on the plot in the autumn for fall plowing. It was established that the level of pollution of the runoff waters and soil erosion products depends on the type of crop being cultivated, method and time of applying the fertilizers, and the intensity of the development of the erosion process. Positive effects of shelterbelts and afforestation on the composition of the surface runoff entering from fields is confirmed by special investigations on experimental drainage basins with a different degree of afforestation and also on combined runoff plots. Runoff-purifying tree stands simultaneously perform water-regulating and erosion control functions and therefore when creating and siting them on drainage basins it is necessary to be guided by the recommendations developed for shelterbelts and plantings having water regulating and erosion control purposes. (Baker-IVI)
W84-02324

EVALUATION OF THE PROSPECTS OF USING NATURAL RADIOISOTOPES WHEN

STUDYING SURFACE WATER-SUPPLY SOURCES OF MOSCOW,
V. D. Vilenskii.
Water Resources, Vol. 9, No. 5, p 507-510, September-October, 1982. 2 Fig, 2 Tab. Translated from Vodnye Resursy, No. 5, p 72-76, September-October, 1982.

Descriptors: *Radioisotopes, *Heavy metals, *Fate of pollutants, Path of pollutants, Surface waters, Radioactive tracers, Moscow, USSR.

The fate of water polluting heavy metals on entering rivers, lakes and reservoirs with wastewaters and surface runoff is of great interest. To evaluate the possible effect on water quality, it is customary to distinguish several forms of transport of metals in rivers: available, less available, or practically unavailable under natural conditions. As a first approximation the behavior of each heavy metal is determined by the rate of passage from a dissolved state into suspended matter and rate of removal of suspended matter into the bottom sediments. Natural radioactive isotopes of the uranium and thorium series can be used for evaluating the temporal characteristics of these processes in surface water bodies and streams. The main requirement in selecting pairs of radioisotopes is that the parent isotope should have greater solubility. Another important requirement is that the radioactive half-life of the daughter radioisotope should make it possible on the basis of the deviation from radioactive equilibrium between daughter and parent isotopes to determine in a wide range and half life of heavy metals in water, which corresponds to the differences in the residence time of the water itself in individual stretches of rivers and reservoirs. Along with the use of natural radioisotopes for estimating the temporal characteristics of removal of radioisotopes from rivers and reservoirs, it is of interest to use certain natural radioisotopes as analogs of heavy metals arriving from a single source. The rather low concentration of radioisotopes in surface water supply sources of Moscow present a definite barrier preventing the wide use of natural radioisotopes for estimating the temporal characteristics of removal of heavy metals from water of reservoirs and rivers. (Baker-IVI)
W84-02328

RADIOISOTOPE INVESTIGATIONS OF PROCESSES OF TECHNOGENIC EFFECTS ON NATURAL WATERS,
A. E. Babinets, V. V. Gudzenko, and V. K. Yanchev.
Water Resources, Vol. 9, No. 561-566, September-October, 1982. 2 Fig, 4 Tab, 8 Ref. Translated from Vodnye Resursy, No. 5, p 158-163, September-October, 1982.

Descriptors: *Water pollution sources, *Radioisotopes, *Groundwater pollution, Radon, Radium, Uranium, Powerplants, Groundwater pollution, Waste dumps, Springs, Radioactive tracers, Plankton, Organic matter, Path of pollutants, USSR.

The use of natural radioactive isotopes makes it possible to trace the change in the composition of groundwaters and to estimate the mixing proportions and also the character and intensity of the interconnection of aquifers with one another and with surface waters. Radiogenic isotopes were used for estimating the seepage from the ash dump storage ponds of the Voroshilovgrad (USSR) regional power station. Similar works are being carried out in the region of sections of the ash dump of the Tripol'e regional power station located on alluvial sand deposits of the right-bank region of the Stugna River. Points of issue of springs with a higher content and anomalously low isotopic ratio of uranium were detected in the region of the ash dumps. Mixing of these waters with waters of the ash dumps leads to a decrease of the U-234/U-238 ratio in the infiltration flow reaching the Stugna River. A noticeable decrease of the radium concentration in water samples taken at negative temperatures in the river and ash dump is observed. The observed decrease of concentrations is apparently related to suppression of plankton, which is confirmed also by an increase of water transparency. Evidently a part of the radium migrates with organics. At present a network of observation wells is being drilled, by means of which the movement of the front of the waters infiltrating from the storage ponds is to be estimated. (Baker-IVI)
W84-02334

INCURSION OF ACID DEPOSITION INTO WESTERN NORTH AMERICA,
Battelle Pacific Northwest Labs, Richland, WA. Environmental Sciences Dept.
W. T. Hinds.
Environmental Conservation, Vol. 10, No. 1, p 53-58, 1983. 4 Fig, 28 Ref.

Descriptors: *Acid rain, *Reviews, Western North America, North America, Nitrogen oxide, Sulfur oxide, Oxides, Environmental effects, Snowmelt, Acid precipitation.

Acidification processes in western North America will probably increase in scope and visibility over the foreseeable future. Localized acidification seems more probable for the next few decades than does a generalized acidified deposition over the western States. At least part of current acid deposition downwind of urban areas is associated with automobile emissions. However, increases in coal combustion for power generation might be expected to increase sulfur dioxide concentrations, along with several related acidifying agents. Interactions of air pollutants with orographic precipitation and snowmelt may bring some areas to public attention much earlier than others, depending upon site-specific matters of climate, topography, soils, water-bodies, and biota. Lakes and streams on windward slopes facing large urban or industrial sources of sulfur and nitrogen oxides may be most seriously at risk. Avoiding acidification may be much easier than amelioration, mitigation, or regulation. This suggests that susceptible landscapes and ecosystems should be identified as soon as possible. Then concerned public and private institutions can agree on specific areas that need protection from acid deposition. (Baker-IVI)
W84-02366

LAKE ONTARIO SEDIMENTS AS INDICATORS OF THE NIAGARA RIVER AS A PRIMARY SOURCE OF CONTAMINANTS,
Canada Center for Inland Waters, Burlington, Ontario. Great Lakes Fisheries Research Branch.
R. L. Thomas.
Journal of Great Lakes Research, Vol. 9, No. 2, p 118-124, 1983. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Water pollution sources, *Lake sediments, *Lake Ontario, *Niagara River, Great Lakes, Mercury, Ecosystems, Vanadium, Cadmium, Chromium, Lead, Copper, Nickel, Polychlorinated biphenyls, Trace metals, Pesticides, Sediments, Water circulation.

A review of sediment data from Lake Ontario clearly identify the Niagara River as a major problem area with respect to contamination of the entire Lake ecosystem. The area subject to investigation was intensified in 1976 with the indication that the source of mirex to the Lake was from the Niagara River. The distribution of contaminants in the lake have indicated the net transport of sediment-bound materials which has assisted in the general understanding of the occurrence of contaminants at many trophic levels in the ecosystem. Mean concentrations of a number of elements in suspended solids centrifuged from the Niagara River in 1974 further indicated that the river is also a major source of chromium, cadmium, vanadium, and arsenic and a lesser though significant source of lead, copper, and nickel. The distribution of mercury along the southern shore of the lake indicates a source in the Niagara River moving in an anti-clockwise gyre into the Niagara Basin with a second more prominent flow along the south shore with dispersion into the Rochester Basin. This agrees with the current circulation of the lake and the probable dispersion patterns from the Niagara River. (Baker-IVI)
W84-02403

DISTRIBUTION OF MAJOR ELEMENTS AND METALS IN SEDIMENT CORES FROM THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environment Contaminants Div.
A. Mudroch.
Journal of Great Lakes Research, Vol. 9, No. 2, p 125-133, 1983. 12 Fig, 18 Ref.

Descriptors: *Niagara River, *Lake Ontario, *Sediments, *Minerals, *Heavy metals, Metals, Sediment transport, Path of pollutants, Mercury, Zinc, Lead, Chromium, Copper, Nickel, Calcite, Clay, Silt, Water pollution.

An investigation was made of the relationship between the changes in metal concentrations in sediments with the distance from the Niagara River mouth and the chemical and physical characteristics of the sediments. Sediment cores were obtained at nine sampling stations in the western basin of Lake Ontario. In addition, surface sediment was collected at three stations on the Niagara Bar. Minerals present at all stations were silica, feldspars, illite/muscovite, chlorite, kaolinite, and calcite. Dolomite was found at some sampling stations as grains of 2 to 63 micro m size. Significantly elevated concentrations of calcite (up to 20%) in the surface sediment (about 0 to 10 cm) at four sampling stations in the western basin and in the entire 25-cm sediment column at the Niagara River mouth indicated increased input of this mineral into Lake Ontario during the past 100 years. Furthermore, sediment concentration profiles of Zn, Pb, Cr, Cu, Ni, and especially Hg at all sampling stations indicated major transport of metals associated with the clay- and silt-size particles from the Niagara River into Lake Ontario (especially north-north-east and east of the river mouth). A significant decrease in Hg loading from the Niagara River during the past 20 years was also observed. Although smaller in magnitude, a similar decrease was found for Pb, Zn, Cr, Ni, and Cu loading. However, elevated Hg concentrations (up to 7 micro g/g above background values) existed in the surface 10 cm of sediment at eight sampling stations. (Author's abstract)
W84-02404

HISTORY OF LAKE ONTARIO CONTAMINATION FROM THE NIAGARA RIVER BY SEDIMENT RADIODATING AND CHLORINATED HYDROCARBON ANALYSIS,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
R. W. Durham, and B. G. Oliver.
Journal of Great Lakes Research, Vol. 9, No. 2, p 160-168, 1983. 7 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake Ontario, *Niagara River, *Water pollution sources, *Chlorinated hydrocarbons, *Sediments, Radioisotope dating, Industrial wastes, Chlorobenzenes, Chlorotoluenes, Hexachlorobutadiene, Octachlorostyrene, Mirex, Polychlorinated biphenyls, History.

Contamination of Lake Ontario by persistent organic compounds began with the development of the chemical industry along the Niagara River. These compounds are discharged to the river where they are scavenged from the water column by sedimenting particulates which in turn settle out in depositional areas of Lake Ontario. Pb-210, Cs-137, and chlorinated hydrocarbon profiles of sediment cores taken about 3 km from the mouth of the Niagara River were determined. Age profiles of the sediments were constructed from the radionuclide measurements and used to determine historic trends of chlorinated hydrocarbon input to Lake Ontario. The historical record found in the sediments for chlorobenzenes, chlorotoluenes, hexachlorobutadiene, octachlorostyrene, mirex, and PCBs is in good agreement with known production and usage patterns of the chemicals. Pollution of Lake Ontario with chlorinated hydrocarbons from the Niagara River is still occurring, but the worst contamination of the lake occurred in the 1960s. (Author's abstract)
W84-02406

FATES OF ORGANIC COMPOUNDS FROM NIAGARA FALLS DUMPSITES IN LAKE ONTARIO,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Kaminsky, K. L. E. Kaiser, and R. A. Hites.
Journal of Great Lakes Research, Vol. 9, No. 2, p 183-189, 1983. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Fate of pollutants, *Lake Ontario, *Niagara River, *Water pollution sources, *Sediments, Pollutant identification, Chlorinated hydrocarbons, Waste disposal, Hydrocarbons, Industrial wastes, Chlorostyrenes, Taffy tar, Electrolysis.

Sediment samples from the western portion of Lake Ontario were analyzed for chlorinated organic compounds using gas chromatography and gas chromatographic mass spectrometry. Both electron impact and negative chemical ionization mass spectrometry were employed. Many of the chlorinated compounds previously found to be leaking into the Niagara River from waste disposal sites in the city of Niagara Falls were identified in the sediments of Lake Ontario. In particular, two unique chlorofluorinated compounds, dichloro(trifluoromethyl)benzophenone and dichloro(trifluoromethyl)-alpha, alpha-difluorodiphenylmethane, were found in the lake's sediment, showing that stable compounds introduced into the Niagara River accumulate to detectable levels 100 km away in Lake Ontario. There is a tendency for compounds entering the lake from the Niagara River to accumulate in the zones of high sedimentation in the southern portions of both the Niagara and Mississauga basins. Chlorinated styrenes as well as several highly chlorinated polycylic aromatic hydrocarbons were also found. They may originate from taffy tar, the residue resulting from the cleanup of chlorine gas produced by electrolysis of NaCl brine using graphite plates. (Moore-IVI)
W84-02408

VOLATILE HALOCARBON CONTAMINANTS IN THE NIAGARA RIVER AND IN LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
K. L. E. Kaiser, M. E. Comba, and H. Huneault.
Journal of Great Lakes Research, Vol. 9, No. 2, p 212-223, 1983. 9 Fig, 2 Tab, 19 Ref.

Descriptors: *Halogenated hydrocarbons, *Lake Ontario, *Niagara River, *Water pollution sources, Carbon disulfide, Freon 11, Methylene chloride, Chloroform, Bromodichloromethane, Tetrachloroethylene, Path of pollutants, Toronto, Hamilton, Ontario, Twelve Mile Creek, Eighteen Mile Creek, Oak Orchard Creek, Black River, Welland Canal.

Water samples from 95 stations in Lake Ontario and 16 stations in the lower Niagara River were analyzed for volatile halocarbons and carbon disulfide. The following contaminants were observed at many stations with their lake-wide means and standard deviations: trichlorofluoromethane (Freon 11), 249 + or - 882 ng/L; methylene chloride, 572 + or - 1,826 ng/L; chloroform, 18 + or - 92 ng/L; bromodichloromethane, 3 + or - 9 ng/L; and tetrachloroethylene, 9 + or - 65 ng/L. Eleven other compounds, including carbon disulfide, 1,1-dichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and tetrachloroethylene were observed at trace levels or absent at most stations. Six compounds were observed in virtually all Niagara River samples and were traceable into the lake. As apparent from the large relative standard deviations for the above, contaminant concentrations varied strongly between stations, indicating areas of contaminant sources. Both industrialized and urban areas, such as Toronto, Hamilton, and the Niagara River, as well as comparatively small tributaries, such as Twelve Mile, Eighteen Mile, and Oak Orchard Creeks, Black River, and the Welland Canal, appear to be sources for several of the observed contaminants. (Author's abstract)
W84-02411

STATISTICAL EVALUATION OF TRENDS IN THE WATER QUALITY OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Aquatic Physics and Systems Div.
A. H. El-Shaarawi, S. R. Esterby, and K. W. Kuntz.
Journal of Great Lakes Research, Vol. 9, No. 2, p 234-240, 1983. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Niagara River, *Water quality, Hydrogen ion concentration, Alkalinity, Phosphorus, Nitrates, Water pollution, Seasonal variation.

Using water quality data collected at Niagara-on-the-Lake, Ontario between 1975 and 1980, pH, alkalinity, total phosphorus, and nitrate concentrations are examined for changes over time. Moving averages, Spearman's rank correlation coefficient and regression methods, which model the seasonal cycle, are used. The yearly seasonal cycle for pH changes in 1978 in such a way that the regression curve, assuming an effect due to the year, drops below that obtained assuming no year to year differences in 1979 and 1980, whereas it was above in 1975 to 1978. This indicates a downward trend in pH, which is supported by negative correlation coefficients for May, August, September, and October. Very similar observations for alkalinity also suggest an increase in concentration, particularly in July, August, and September. The regression approach for total phosphorus indicated no year to year changes. (Moore-IVI)
W84-02412

CHLORINATED ORGANIC CONTAMINANTS IN WATER AND SUSPENDED SEDIMENTS OF THE LOWER NIAGARA RIVER,
Inland Waters Directorate-Ontario Region, Burlington. Water Quality Branch.
K. W. Kuntz, and N. D. Warry.
Journal of Great Lakes Research, Vol. 9, No. 2, p 241-248, 1983. 1 Fig, 9 Tab, 12 Ref.

Descriptors: *Niagara River, *Suspended sediments, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Water sampling, Lake Ontario, Ontario, Mirex, DDT, Lake Erie, Water pollution sources.

Suspended sediment and raw water samples have been collected and analyzed for organochlorines and PCBs from a fixed location in the lower Niagara River at Niagara-on-the-Lake (Ontario) approximately weekly since 1979. Eight of the 19 organochlorine compounds measured were detected in more than 50% of the water samples analyzed, while 11 of the 19 compounds were detected in more than 50% of the suspended sediments collected at Niagara-on-the-Lake. Of the 10 chlorobenzene isomers measured, the one with the greatest usage (1,4-dichloro) occurs in largest concentrations in the suspended sediments at Niagara-on-the-Lake. Other chlorobenzene isomers commonly occurring in suspended sediments are 1,2 and 1,3 dichloro, 1,2,4-trichloro, 1,2,3,4-tetrachloro, pentachloro, and hexachloro. All isomers of chlorobenzene occurred in more than 70% of the suspended sediment samples collected. Total loadings to Lake Ontario calculated from these data indicate that PCB loadings are about twice as high as previously reported, while mirex and total DDT have decreased slightly. Although concentrations of contaminants in suspended sediments are usually higher than those measured in water samples, they are responsible for only about 40% of the total loadings or PCBs, DDT, and HCB, and significantly less for other organochlorine contaminants. Therefore, the data indicate that, to estimate total contaminant loadings, the water fraction must be sampled. Lake Erie is not the major source of such organic contaminants as PCBs and chlorobenzenes because contaminant levels in Lake Erie bottom sediments are 10 times lower for PCBs and 20 times lower for chlorobenzenes than in Niagara-on-the-Lake suspended sediments. (Author's abstract)
W84-02413

STUDIES OF TRACE CONTAMINANTS, NUTRIENTS, AND BACTERIA LEVELS IN THE NIAGARA RIVER,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
P. B. Kauss.
Journal of Great Lakes Research, Vol. 9, No. 2, p 249-273, 1983. 11 Fig, 8 Tab, 34 Ref.

Descriptors: *Niagara River, *Water pollution sources, *Lake Ontario, *Ontario, *New York, Tonawanda Channel, Heavy metals, Phenols, Polychlorinated biphenyls, Organochlorine pesticides, Mirex, Bacteria, Monitoring, Nutrients, Spatial distribution, Temporal distribution.

Sediment and water quality of the Niagara River were investigated during 1979 and 1980 to determine spatial and temporal differences in the levels of trace contaminants (heavy metals, phenolics, PCBs, and organochlorine pesticides) as well as nutrients and bacteria. Data from these studies as well as recent biomonitoring studies indicate that the Niagara River continues to be a source of such contaminants as PCBs, BHCs, mirex, and heavy metals to Lake Ontario. The major source of the contaminants is the highly industrialized and urbanized Tonawanda Channel area in the upper section of the river. Although a substantial improvement in phenolics levels was noted in the river since earlier surveys in 1971, bacterial and phosphorus levels show no significant changes, particularly near the U.S. mainland shore of the Tonawanda Channel and near the Buffalo River mouth. (Author's abstract)
W84-02414

VOLATILE CONTAMINANTS IN THE WELLAND RIVER WATERSHED,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
K. L. E. Kaiser, and M. E. Comba.
Journal of Great Lakes Research, Vol. 9, No. 2, p 274-280, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Volatile compounds, *Water pollution sources, *Welland River, Ontario, Niagara River, Carbon disulfide, Methylene chloride, Chloroform, Industrial wastes, Dilution, Degradation, Volatilization.

Surveys of selected volatile contaminants in water of the Welland River, a tributary to the Niagara River, in 1980 and 1981 show high levels of carbon disulfide, methylene chloride, and chloroform immediately below two industrial outfalls. Downstream from these point sources, a rapid decline in the contaminant concentrations is noted due to dilution, degradation, and/or volatilization of the compounds. Although toxic effects of other components of these effluents have been observed, the concentrations of the volatile contaminants are several orders of magnitude lower than those at which acute toxic effects on biota are observed. (Author's abstract)
W84-02415

COMPARTMENTAL DISTRIBUTION OF ORGANOCHLORINE CONTAMINANTS IN THE NIAGARA RIVER AND THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
M. E. Fox, J. H. Carey, and B. G. Oliver.
Journal of Great Lakes Research, Vol. 9, No. 2, p 287-294, 1983. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Organochlorine compounds, *Niagara River, *Lake Ontario, Fate of pollutants, Benthic fauna, Suspended solids, Sediments, Bioaccumulation, Chlorobenzenes, Hexachlorobutadiene, Polychlorinated biphenyls, Trophic level, Partition coefficient.

Persistent organochlorine contaminants are present in the Niagara River because of past and present industrial activity in the area. In order to extend past studies of organochlorine contaminants in the river, the fate of some of these compounds when enter Lake Ontario and the aquatic food chain was examined. Ten chlorobenzenes (CB), hexachlorobutadiene (HCBD), and PCBs were measured in Niagara River water and suspended solids, and in western Lake Ontario sediments and benthic fauna. High levels of these contaminants were found on all fractions of the river suspended solids, but the

larger particles contained much higher concentrations than the smaller particles. A portion of the CBs, HCBD, and PCBs present in the lake sediments was available to benthic organisms. A trend toward greater bioaccumulation for compounds having higher octanol-water partition coefficients was observed at all trophic levels. The relative accumulation factor for the more lipophilic compounds increases in higher trophic levels. (Moore-IVI)
W84-02417

INFLUENCE OF THE NIAGARA RIVER ON CONTAMINANT BURDENS OF LAKE ONTARIO BIOTA,
Canada Centre for Inland Waters, Burlington, Ontario. Dept. of Fisheries and Oceans.
D. M. Whittle, and J. D. Fitzsimons.
Journal of Great Lakes Research, Vol. 9, No. 2, p 295-302, 1983. 3 Fig, 5 Tab, 20 Ref.

Descriptors: Lake Erie, *Lake Ontario, *Niagara River, *Aquatic animals, *Water pollution sources, Fish, Zooplankton, Invertebrates, Trace metals, Organic compounds, Food chains, Polychlorinated biphenyls, DDT, Mirex, Mercury, Fate of pollutants, Bioaccumulation, Sediment-water interfaces.

Top predator and forage fish species, netplankton (>153 micro m), zooplankton, and benthic macroinvertebrates from Lake Erie and Lake Ontario were analyzed for whole body levels of trace metals and organic contaminants. Comparison of contaminant concentrations in similar aquatic food chains from both lakes indicated that levels of PCB, DDT, mirex, and mercury are significantly greater ($P<0.05$) in the biota of Lake Ontario. The Niagara River, the single largest tributary to Lake Ontario, was confirmed as a major source of organic contaminants and trace metals. Organic contaminants are adsorbed to the particulate load of the river and dispersed throughout Lake Ontario by the circulating currents. There was no signficant regional difference ($P<0.05$) in the degree of contaminant accumulation by the pelagic food chain of Lake Ontario. Conversely, both inorganic and organic contaminant levels in the demersal amphipod, Pontoporeia affinis, were significantly different ($P<0.05$) between the eastern and western basins of Lake Ontario. The uptake and concentration of contaminants at the sediment-water interface is suggested as a possible mechanism to explain this observed difference. (Author's abstract)
W84-02418

HISTORICAL RECORDS OF METAL POLLUTION IN SEDIMENTS OF TORONTO AND HAMILTON HARBOURS,
National Water Research Inst., Burlington, Ontario.
J. O. Nriagu, H. K. T. Wong, and W. J. Snodgrass.
Journal of Great Lakes Research, Vol. 9, No. 3, p 365-373, 1983. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Water pollution sources, *Sediments, *Metals, *Hamilton Harbor, *Toronto Harbor, Ontario, History, Effluents, Storm wastewater, Industrial wastes, Spoil disposal, Zinc, Iron, Copper, Manganese, Lead, Chromium, Lake Ontario.

The sediments of Hamilton and Toronto Harbors contain some of the oldest records of metal pollution in the Great Lakes basin. The fluxes of Cd, Cr, Cu, Ni, Pb, Zn, Fe, and Mn into the two harbors have been estimated from the analyses of core samples dated by the Pb-210 technique. The contrasting metal levels in the two harbor sediments are related to the differences in the disposal strategies of the dredged spoils and the sources of metal pollution in the harbors. Hamilton Bay functions as the receiving water for effluent from numerous industrial operations and for treated wastewaters and untreated storm sewer overflows. Direct municipal and industrial discharges into Toronto Harbor are in no way near those of Hamilton Bay. Prior to World War II, a significant fraction of the spoils from Hamilton and the associated shipping channels was dumped into the deeper waters of the bay. The dredged spoils from Toronto harbor and shipping lanes have been used in land reclamation programs or dumped well outside the harbor. The Zn and Fe concentrations of 5 to 8 mg/g and 10 to 13% dry wt. in Hamilton Harbor sediments, which are among the highest recorded in any harbor, can be related to effluent discharges from the large local iron and steel plants. Over 80% of the Cu, Zn, Mn, and Fe inputs into Hamilton Harbor come from industrial discharges. Municipal effluents account for 28% of the Cr, 23% of the Pb, 11% of the Cu, and only 1% of the Fe delivered annually into the harbor. An inventory of the sources and sinks of pollutant metals in Hamilton Bay shows a substantive export of the metals to Lake Ontario. (Moore-IVI)
W84-02423

PHYSICO-CHEMICAL MODEL OF TOXIC SUBSTANCES IN THE GREAT LAKES,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
R. V. Thomann, and D. M. Di Toro.
Journal of Great Lakes Research, Vol. 9, No. 4, p 474-496, 1983. 11 Fig, 4 Tab, 54 Ref. EPA cooperative agreements CR805916 and CR807853.

Descriptors: *Physicochemical properties, *Lakes, *Fate of pollutants, *Great Lakes, Polychlorinated biphenyls, Particulate matter, Sorption, Desorption, Sediment-water interfaces, Suspended solids, Plutonium, Model studies.

Mass balance principles, incorporating principal mechanisms of particulate sorption-desorption, sediment-water and atmosphere-water interactions, and chemical and biochemical decay were used to construct a physico-chemical model of the fate of toxic substances in the Great Lakes. Solids flux balance calculations are not sufficient to determine the presence or absence of any sustained sediment resuspension effects since only net losses to the sediment can be estimated from solids budget computations. For time variable toxic fate modeling, it is necessary to determine the solids concentration in the water column which, for the open waters of the Great Lakes, is subject to some variability principally due to a lack of reliable data on open lake suspended solids. If the suspended solids in the Lakes are higher than used herein (0.5 mg/L for the upper lakes and Lake Ontario), then the net loss rate is less and resulting resuspension velocities increase. This will tend to decrease the response times of the lakes to reduction in external loads. Results of the application of the model to PCB levels in the Great Lakes indicate that the estimated upper range of present PCB loadings (from 4,080/yr for Lake Ontario to 9,500 kg/yr for Lake Superior) without volatilization is probably too high; from the available data it is not possible at the present time to distinguish the appropriate combination of loading and loss due to volatilization; and the response times due to load reduction of PCB may vary by an order of magnitude depending on the magnitude of the volatilization exchange rate - 50% response times vary from a few years with volatilization to 5 to 10 years or longer without volatilization. Comparison of these response times to observed declines in concentrations of PCB for Lake Michigan bloaters indicates that volatilization of PCB is occurring at an exchange rate of about 0.1 m/d at least for that lake. (Baker-IVI)
W84-02431

ANALYSIS OF POLYCHLORINATED BIPHENYL (PCB) LOADING TRENDS IN LAKE MICHIGAN,
Limno-Tech., Inc., Ann Arbor, MI.
P. W. Rodgers, and W. R. Swain.
Journal of Great Lakes Research, Vol. 9, No. 4, p 548-558, 1983. 3 Fig, 4 Tab, 38 Ref.

Descriptors: *Polychlorinated biphenyls, *Fish, *Lake Michigan, Great Lakes, Mathematical models, Public health, Chubs, Water pollution, Pollution load.

An historical loading trend for polychlorinated biphenyls was inferred using PCB concentrations in coregonid fishes collected from Lake Michigan between 1972 and 1980. The dynamics of PCBs are described using a mass balance model assuming that historical fish concentrations are proportional to concurrent water column concentrations of PCB. PCB loading during this period to the lake is described by a linearly decreasing trend. The calibrated model also forecasts the response of selected fish species to various loading scenarios. Forecast results indicate that a continuously decreasing load will result in compliance with US and Canadian guideline levels for human consumption. The availability of precise measurements of water : fish distribution coefficients will improve the accuracy of the predictions. (Baker-IVI)
W84-02436

OBSERVATIONS ON THE TIME OF TRAVEL OF WAVES IN THE RIVER SKERNE, ENGLAND, AND THE EFFECT OF AQUATIC VEGETATION,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W84-02472

NITRATE TRENDS IN THE COASTAL PLAIN AQUIFER OF ISRAEL,
Israel Water Commission, Tel Aviv. Water Pollution Control Unit.
Y. Kanfi, D. Ronen, and M. Magaritz.
Journal of Hydrology, Vol. 66, No. 1-4, p 331-341, October, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Nitrates, *Coastal aquifers, *Israel, Mineralization, Water pollution sources, Groundwater pollution.

The variation in the average concentration of nitrates in the Coastal Plain aquifer of Israel was determined. Sampling was performed on 932 pumping wells which were distributed throughout the aquifer, comprising 60% of all the pumping wells in the aquifer. Sampling was done in the summer of 1973 and again in the summer of 1981. In 1973 the average nitrate concentration was 52 mg/l, which increased at a rate of 0.13 mg/l/year. The rates of increase of the average nitrate concentration were 1.45 mg/l/year in the 1950s and 0.56 mg/l/year during the 1960s. There is some evidence which indicates that the rate of nitrate concentration was even higher for the period 1920-1950. The initial high rates of nitrate increase were probably due to mineralization of about 400 kg N per 1000 sq m released when cultivation of virgin soils in the Coastal Plain began during the first half of this century. The reduction in the rate of nitrate increase indicates that the nitrogen system in the aquifer may be approaching a new steady state. (Baker-IVI)
W84-02475

5C. Effects Of Pollution

ORGANOCHLORINE RESIDUES IN BROOK TROUT FROM REMOTE LAKES IN THE NORTHEASTERN UNITED STATES,
Maine Cooperative Fishery Research Unit, Orono.
T. A. Haines.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 47-54, July 1983. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Trout, *Pesticide residues, *Organochlorine pesticides, Acid precipitation, Water pollution sources, Regression analysis, Water chemistry, Maine, New Hampshire, Vermont, Air pollution, DDE, Polychlorinated biphenyls.

Organochlorine residues were analyzed in brook trout (Salvelinus fontinalis) collected from six undistributed lakes in Maine, New Hampshire and Vermont. The residues (whole body) were compared among age groups of fish and were correlated by regression analyses with water chemistry factors that might be affected by acid precipitation. There were significant differences in the organochlorine content of fish from different lakes but not among age groups of fish within each lake or among all lakes. There were no significant correlations between the water chemistry values measured and organochlorine content of the fish. Inasmuch as no organochlorine pesticides have been

used within the lake watersheds, the compounds must have reached these lakes by atmospheric transport. (Author's abstract)
W84-02126

EFFECT OF VEGETABLE OIL FACTORY EFFLUENT ON OVARIAN RECRUDESCENCE IN THE FRESH WATER TELEOST, CHANNA PUNCTATUS (BL.),
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
P. K. Saxena, and R. Bhatia.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 55-61, July 1983. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Food-processing wastes, *Reproduction, *Channa punctatus, *Toxicity, Fish, Water pollution effects, Effluents, Vegetable oil wastes, Ovaries.

The effect of chronic exposure to a sublethal concentration (5%) of vegetable oil factory effluent on ovarian maturation of Channa punctatus was studied. The ovarian weights in effluent-exposed and control groups did not vary significantly up to 60 days of exposure. After 90 days of exposure, the ovarian weights in the effluent-exposed group were lower than in the control group, and this continued until the termination of the experiment at 120 days. After 60 days of exposure, the percentage of stage II oocytes was lower, while that of atretic oocytes was higher in the ovaries of effluent exposed fish. At 120 days of exposure, the percentage occurrences of stage II and atretic oocytes were higher in the exposed fish, while the percentage occurrence of stage III oocytes was higher in the control fish. This suggests that effluent exposure not only retarded the formation of stage III oocytes, but also caused higher incidence of atresia. (Moore-IVI)
W84-02127

CLINICAL APPROACH TO STUDY THE POLLUTANTS INTOXICATION IN A FRESHWATER TELEOST CLARIAS BATRACHUS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
S. S. Dhillon, and A. K. Gupta.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 63-68, July 1983. 3 Tab, 16 Ref.

Descriptors: *Aldrin, *Swascofix, *Toxicity, *Clarias batrachus, *Blood, Fish, Organochlorine pesticides, Detergents.

The effect of sublethal concentrations of aldrin (an organochlorine pesticide) and Swascofix CD-38 (an anionic detergent) on certain hematological parameters of C. batrachus was studied after 10, 20, and 30 day exposures. The parameters studied were clotting time, prothrombin time, hemoglobin, red blood cells, white blood cells, packed cell volume, mean cell hemoglobin, mean cell hemoglobin concentration, mean cell volume, specific gravity and pH. Clotting time, mean cell hemoglobin, and mean cell volume were found to decrease with increasing pollutant concentrations and time of exposure, while all other parameters showed an increase. However, pH and specific gravity remained generally unaffected. The increase in packed cell volume and hemoglobin can be attributed to the catalyzing action of aldrin and Swascofix CD-38 due to which the body iron stores are incorporated into hemoglobin. (Moore-IVI)
W84-02128

EFFECT OF MERCURIC CHLORIDE ON ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 265-271, October 1983. 4 Tab, 15 Ref.

Descriptors: *Mercuric chloride, *Electron transport system, *Sediments, Microorganisms, Enzymes, Anaerobic conditions, Aerobic conditions.

The effect of mercuric chloride (HgCl2) on electron transport system (ETS) activity in sediment was studied using the reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) to water insoluble iodonitrotetrazolium formazan (INT-formazan) by respiring microorganisms and sediment enzymes. The effect of HgCl2 on ETS activity was more pronounced in aerobically incubated sediment than in anaerobically incubated sediment. The EC50 value for the inhibition of ETS activity in aerobically incubated sediment at 10 and 20 degrees C was 40.9 + or - 16.2 and 48.8 + or - 4.1 micro g/g HgCl2, respectively. The EC50 value for anaerobically incubated sediment in the presence of HgCl, at 4, 10, 20 degrees C was 153.0 + or - 8.1, 173.1 + or - 8.2, and 199.1 + or 15.2 micro g/g HgCl2, respectively. (Author's abstract)
W84-02131

INCIDENCE OF PLASMID-LINKED ANTIBIOTIC-HEAVY METAL RESISTANT ENTERICS IN WATER-SEDIMENT FROM AGRICULTURAL AND HARBOR SITES,
Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
J. A. Mietz, and R. E. Sjogren.
Water, Air, and Soil Pollution, Vol. 20, No. 2, p 147-159, August 1983. 9 Tab, 28 Ref.

Descriptors: *Antibiotics, *Heavy metals, *Enteric bacteria, *Harbors, *Agricultural runoff, *Plasmids, Water pollution effects, Antibiotic resistance, Sediments, Ampicillin, Bacterial transformation, Lead, Zinc, Cobalt, Tellurium, Mercury, Drug resistance.

This study assesses the impact of antibiotics used in clinical and veterinary practices on the incidence of antibiotic-heavy metal resistant enterics in fresh water and sediment from agricultural and harbor sample sites. A total of 848 bacterial strains of the family Enterobacteriaceae was isolated from agricultural and lake harbor samples and identified to genus level. These were examined for antibiotic - heavy metal resistance. A select smaller number of these isolates were also examined for the presence of plasmids and ability to transfer antibiotic resistance via conjugation or transformation. More than 85% of the 848 isolates from all four sites were resistant to Pb, Zn, and Co while 5.6% to 16% were resistant to Te and 2.4% to 5.7% to Hg. The ranking of metal resistance according to frequency was the same as the frequency of metal occurrence in sediment samples. Of the total isolates tested, 87% were resistant to six or more antibiotics and 74% were also simultaneously resistant to Co, Zn, and Pb. Testing the resistance of the water isolates to antibiotics used solely in animal husbandry-veterinary medicine indicated that 55.6% of the agricultural isolates possessed resistance to these antibiotics while only 31.9% of the isolates from harbor water showed resistance to the same antibiotics. Of 41 ampicillin resistant isolates examined, 16(39%) were capable of transferring antibiotic - heavy metal resistance markers via conjugation. From this same group, plasmid DNA preparations were made. Of these latter preparations, 67% transformed recipient E. coli cells while 58% possessed discernible, often multiple plasmids when examined by gel electrophoresis. (Author's abstract)
W84-02135

VENTILATORY RESPONSES OF BLUEGILL SUNFISH TO SUBLETHAL, FLUCTUATING EXPOSURES TO HEAVY METALS (ZN(++) AND CU(++)),
Mississippi Univ., University. Dept. of Biology.
K. W. Thompson, A. C. Hendricks, G. L. Nunn, and J. Cairns, Jr.
Water Resources Bulletin, Vol. 19, No. 5, p 719-727, October, 1983. 6 Fig, 5 Tab, 24 Ref. EPA grant R80 52 740 10.

Descriptors: *Bluegill, *Bioindicators, *Toxicity, Heavy metals, Ventilatory response, Copper, Zinc, Environmental quality.

Minicomputer interfaced, continuous, noncontact sensing of the ventilatory behavior of the bluegill (Lepomis macrochirus) was used to investigate the response to exposure to solutions of copper and zinc under various modes of application. Fish respond to sublethal concentrations of these toxicants by increasing the average ventilatory rate as well as decreasing the amplitude of the ventilatory signal. The comparison of ventilatory data between individuals by conventional parametric methods is statistically valid. The use of sublethal doses of copper and zinc are detectable using the ventilatory response. The use of the ventilatory amplitude is a valuable supplement to the rate for the purpose of monitoring the quality of the aquatic environment. The three application patterns chosen for this study connot be statistically differentiated by the methods used in this analysis. (Moore-IVI)
W84-02159

LIMNOLOGY OF LAKE WABUKAYNE, A STORM-WATER IMPOUNDMENT,
Environmental Council of Alberta, Edmonton.
For primary bibliographic entry see Field 2H.
W84-02172

TOXICITY OF JET FUELS TO FISH - II; THE TOXICITY OF JP-8 TO FLAGFISH (JORDANELLA FLORIDAE) AND RAINBOW TROUT (SALMO GAIRDNERI) AND GOLDEN SHINERS (NOTEMIGONUS CHYSOLEUCAS),
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
S. A. Klein, and D. Jenkins.
Water Research, Vol. 17, No. 10 p 1213-1220, 1983. 9 Fig, 6 Tab, 6 Ref.

Descriptors: *Fuel, *Water pollution effects, *Toxicity, *Trout, *Flagfish, *Shiners, Water soluble fraction, Bioassay, Growth, Hatching, Mortality, Bioaccumulation, Depuration, JP-8.

JP-8 is a widely-used commercial and military jet fuel which may reach the aquatic environment by several avenues. JP-8 is a kerosene-based aviation fuel which consists of a complex mixture of aliphatic and aromatic hydrocarbons and is similar to the commercial aviation fuel Jet A-1. The major difference is that JP-8 contains ethylene glycol monomethyl ether. The toxicity of JP-8 to cold and warm water fish was investigated to help define the impact on fresh water species. Fish were exposed to the water soluble fraction (WSF) of JP-8 in static acute bioassays and continuous-flow bioassays of approximately 4 months duration. The goal was to determine the 96-h LC50 and the long-term no effect level on the life cycle. The acute toxicity to golden shiner, a warm water fish, was found to be unaffected by pH in the range of 7.3-9.1. Flagfish growth was not affected by the presence of 1.7 mg/l WSF of JP-8, but the no effect level on rainbow trout was < 1.4 mg/l (the lowest level tested). Neither lethality nor egg hatching was a conclusive indicator of species sensitivity to the WSF of JP-8. Accumulation of fuel in tissues does not explain the greater toxicity of WSF of JP-8 to rainbow trout over its toxicity to flagfish. The accumulation ratio in flagfish is double that of trout. Depuration from flagfish is fairly rapid (90% in 14 days). Accumulation of JP-8 in fish tissue occurred at all aqueous fuel concentrations tested, so the presence of even very low levels of fuel in a body of water would cause off tastes and flavors in fish. (Moore-IVI)
W84-02175

PRELIMINARY STUDIES ON THE USE OF THE HETEROTROPHIC ACTIVITY METHOD TO EVALUATE ACID-STRESS EFFECTS IN AQUATIC ENVIRONMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
G. D. Ferroni, L. G. Leduc, and C. G. Choquet.
Water Research, Vol. 17, No. 10, p 1379-1384, 1983. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Acid stress, *Acid lakes, *Acid rain, *Heterotrophic activity method, Phytoplankton, Ice cover, Glucose mineralization, Hydrogen ion concentration, Heavy metals, Aquatic environment, Silver Lake, Bethel Lake, Ontario.

The heterotrophic activity method was used to study the effects of acidification on mineralization activity in a lake in which acid rain is simulated (Bethel Lake), and in an acid-stressed lake (Silver Lake). In the fall, the rates of glucose mineralization by the planktonic microflora of Bethel Lake followed Michaelis-Menten kinetics at the in situ pH (7.5) and at the two experimental pH's (5.5 and 5.0). Turnover times for glucose increased with decreasing pH and, correspondingly, V max values decreased with decreasing pH. During ice-cover, only the in situ pH (6.85) gave a Michaelis-Menten response for glucose mineralization. At the experimental pH's, glucose mineralization activity was negligible. Analyses for soluble copper and nickel, the most important heavy metals in this environment with respect to concentration, indicated that the reduced glucose mineralization rates were not the result of acidification increasing the heavy metal concentrations (and, therefore, their toxicity). For the acid-stressed Silver Lake, glucose mineralization was negligible at the in situ pH (4.3) and at the experimental pH's (5.5 and 7.0) as well. The heterotrophic activity method is very useful in simulated acid rain studies on the aquatic environment, and it has considerable potential in the investigation of decomposition activities in acid-stressed lakes. Many of the lakes of interest are not acid stressed to the same degree as Silver Lake, and would mineralize substrates such as glucose at measurable rates and give the typical Michaelis-Menten response. (Moore-IVI)
W84-02188

EFFECT OF SANITATION EFFORTS ON THE MANGANESE CYCLE IN LAKE CONSTANCE (OBERSEE AND UNTERSEE-GNADENSEE) (DIE AUSWIRKUNGEN VON SANIERUNG-MASSNAHMEN AUF DEN MANGANHAUSHALT DES BODENSEES (OBERSEE UND UNTERSEE-GNADENSEE)),
Landesansalt fur Umweltschutz Baden-Wuettemberg, Langenargen (Germany, F.R.). Inst. fur Seenforschung und Fishereiwesen.
H. Rossknecht.
Archiv fur Hydrobiologie, Vol. 97, No. 3, p 346-355, July, 1983. 4 Fig, 11 Ref.

Descriptors: *Lakes, *Phosphorus, *Manganese, *Wastewater treatment, Oxygen, Sediment loading, Organic matter, Agriculture, Lake Constance.

Intensive purification measures were carried out in the catchment area of Lake Constance during the last 6 to 7 years. Prior to any attempted improvements, increased inputs of organic matter after the start of the farming period with the resulting reduction processes in the sediment-water layer brought about a remobilization of Mn(II) in the Obersee in July. This Mn(II) was immediately oxidized to Mn(III/IV) probably catalyzed by manganese bacteria, Metallogenium, the concentration of which showed a parallel course to those of Mn(III/IV). The Mn(II) values therefore remained generally below 1 microgram/liter. No oxygen could be detected for weeks in the hypolimnic waters of the Gnadensee during the summer. The manganese equilibrium was therefore shifted to the dissolved Mn(II) in 1978 and 1979. In the following two years an unexpected increase in oxidation of Mn(II) was noted. This indicated a gradual change in the redox situation of the Gnadensee. The coincidence of this change with the completion of sewage treatment plants is viewed as a first indication of the efficiency of these new purification measures. (Baker-IVI)
W84-02242

INFLUENCE OF ANTHROPOGENIC EUTROPHICATION: EFFECTS ON FISH IN THE FORM OF BLUE-GREEN ALGAE MASS DEVELOPMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. Ya. Malyarevskaya.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 417-424, August, 1983. 5 Tab, 5 Ref.

Descriptors: *Eutrophication, *Fish, *Cyanophyta, *Toxicity, Water pollution effects, Algal toxins, Metabolism.

The influence of eutrophication after-effects on fish in the form of blue-green algae depends on a complicated system of biotic and abiotic factors. The effect is manifested in disturbances of plastic and energy metabolism ratios in fish in favor of the dominance of the latter, resulting from the disturbance of regulators of cellular metabolism and in particular of the cellular metabolism of nicotinamide coferments and coferment vitamins. Nitrogen consumption by fish exposed to the algae decreased and the majority of it was used for energy processes. When fish were treated with lethal amounts of blue-green algae, metabolic changes were even greater. The nitrogen balance of these fish was negative, and respiration was intensified. Lethal amounts of the blue-green resulted in increases of some of the free amino acids but a reduction in protein hydrolysate. These changes caused disturbances in protein synthesis and suppression of plastic metabolism. The mechanism of blue-green algae impact on fish can be described as follows: biologically active substances, excreted by the blue-greens in the process of metabolism and degradation (in particular, toxins) under conditions of increased permeability of fish cells penetrate into cells and alter the ionic ratio. The redox ratio of nicotinamide coferments shifts in prevalence of restored forms which intensify glycolytic processes and directs carbohydrate degradation to the anaerobic. The changes ultimately affect the Krebs cycle and respiratory chain and the pentose phosphate shunt in tissues where they are present. (Baker-IVI)
W84-02243

ACUTE TOXICITY OF PISCICIDE ANTIMYCIN-A, MOLLUSCICIDE BAYER-73 AND LAMPRICIDE-3 TRIFLUOROMETHYL-4-NITROPHENOL (TFM) TO THE SNAIL VIVIPARUS BENGALENSIS L.,
K.L.D.A.V. Coll., Roorkee (India). Dept of Zoology.
P. K. Gupta, and V. S. Durve.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 540-550, August, 1983. 8 Tab, 40 Ref.

Descriptors: *Snails, *Toxicity, *Pesticides, Bioassay, Antimycin-A, Bayer-73, TFM, Molluscides, Piscicides, Lampricides.

For acute-toxicity tests, a freshwater snail Viviparus bengalensis L. was exposed to a piscicide (Antimycin A), a molluscicide (Bayer 73) and a lampricide (3-trifluoromethyl-4-nitrophenol (TFM)). Static bioassay method was adopted for the evaluation of the toxicity of these chemicals. The lethal concentrations (LC16, LC50 and 95% fiducial limits and LC84), slope functions regression equations, heterogeneity factors, median, survival periods, analysis of variance, presumable harmless concentrations and relative potencies of the three toxicants were worked out for 12, 24, 48, 72 and 96 hr exposures. The rank order toxicity among the three toxicants was Antimycin A > Bayer 73 > TFM. Bayer-73 was more toxic than Antimycin A up nto 48 hr exposure. Beyond this period, its toxicity decreased and Antimycin A was found to be most toxic. Based upon the 96 hr LC50, Bayer-73 was 8.45 and TFM 764.83 times less toxic than Bayer-73. (Moore-IVI)
W84-02247

OCCURRENCE OF A TOXIC DINOFLAGELLATE IN THE INDIAN RIVER SYSTEM,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
D. R. Norris.
Florida Scientist, Vol. 46, No. 3/4, p 150-153, 1983. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Dinoflagellates, *Indian River, *Banana River, *Florida, Gonyaulax, Fishkill, Red tide, Hypnozygotes, Lagoons.

A compilation is presented of published and unpublished references to Gonyaulax monilata in the Banana and Indian Rivers (Florida) along with the available hydrographic data and maximum cell concentrations. There were only two references to fish kills but even then there was not enough evidence to implicate G. monilata as the direct cause. The fish kills could have been due to oxygen depletion. The apparent lack of motile cells for months, if not years, in a given location supports the belief that benthic resting cysts or hypnozygotes are the only source for the seed population of G. monilata blooms in the Indian River lagoon system. (Baker-IVI)
W84-02249

PUBLIC HEALTH AND WATER QUALITY SIGNIFICANCE OF VIRAL DISEASES TRANSMITTED BY DRINKING WATER AND RECREATIONAL WATER,
Rhode Island Univ., Kingston. Dept. of Microbiology.
V. J. Cabelli.
Water Science and Technology, Vol. 15, No. 5, p 1-15, 1983. 3 Fig, 2 Tab, 57 Ref. NOAA grant 80RAC00106.

Descriptors: *Viruses, *Public health, *Drinking water, *Swimming, Water pollution effects, Epidemiology, Hepatitis, Gastroenteritis, Water pollution effects, Recreation, Beaches, Wastewater pollution, Water quality standards.

A review of the available information from case and outbreak reports and the results of prospective and retrospective studies revealed that the potential for the spread of viral diseases by the use of fecally contaminated drinking and recreational water has only been realized for infectious hepatitis and viral gastroenteritis. These two, however, are the most serious and prevalent, respectively, of the water-related diseases. A model is described for predicting the beach specific, swimming-associated rates and annual number of cases of gastroenteritis. The inputs are the swimming-associated, gastroenteritis rate-bathing water enterococcus density regression equation developed from the USEPA prospective epidemiologic-microbiologic studies and the distribution of enterococcus density estimates and annual number of swimmers at the beach in question. In general, the gastroenteritis rates predicted from the enterococcus model were less than those from the corresponding E. coli model. Detectable rates at the 75 percentile level and rates approaching or exceeding 5/1000 swimmers at the 90 percentile level were predicted for 7 and 14, respectively, of the 87 sampling station-beach associations. All but one of the fourteen stations were potentially impacted by known municipal wastewater discharges and two of the associated beaches were posted as unsafe for swimming. The inapplicability of the model to beaches impacted with small, immediate sources of fecal wastes or stormwater run-off is noted. The limitations in the use of findings from the analysis of outbreak reports in the evaluation and establishment of water quality criteria, and hence, the need for prospective, drinking water and shellfish epidemiological studies is discussed. The need for such studies also derives from the results of the bathing beach study in that they suggest that cases of gastroenteritis are occurring with acceptable drinking and shellfish growing waters. The need for tissue culture enumerative methods for the viral gastroenteritis agents and methodology for determining the biological decay coefficients for these agents and their indicators is noted. (Author's abstract)
W84-02255

PREVALENCE OF VIRAL HEPATITIS AND OTHER ENTERIC DISEASE IN COMMUNITIES UTILIZING WASTEWATER IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 3C.
W84-02258

TAINTED FISH CAUSED BY PETROLEUM COMPOUNDS - A REVIEW,
Kagoshima Univ. Shimoarata (Japan). Faculty of Fisheries.
T. Motohiro.
Water Science and Technology, Vol. 15, No. 6-7, p 75-83, 1983. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Water pollution effects, *Oil pollution, *Hydrocarbons, *Fish, *Taste, Aromatic compounds, Paraffins, Sulfur compounds, Fish food, Algae.

A number of compounds present in petroleum can produce an oily flavor in fish. These are saturated and unsaturated paraffins, aromatic hydrocarbons and sulfur compounds. The intensity of oily flavor to some extent depends upon type, number of carbons and molecular structure of causative hydrocarbons. The qualitative and quantitative analyses indicate that there are many different types of petroleum compounds to which off-flavors are attributed, since feeding behavior to oil tainted food differs with species of aquatic organisms. Benzothiophene, toluene, xylene and benzene may not only produce an oily flavor in fish, but also they inhibit the enzyme reactions in the energy transfer system. Methionine synthesis in fresh sea weeds can also be inhibited as indicated by lower levels of dimethyl-beta-propiothetin in sea weeds grown on the oiled rock. (Author's abstract)
W84-02271

CASE STUDIES ON OFF-FLAVOURS IN SOME NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5F.
W84-02277

ODOROUS COMPOUNDS OF DIFFERENT STRAINS OF ANABAENA AND NOSTOC (CYANOBACTERIA),
Institut fur Chemische Pflanzenphysiologie der Universitat, Tubingen (Germany, F.R.).
S. Mohren, and F. Juttner.
Water Science and Technology, Vol. 15, No. 6-7, p 221-228, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Odor, *Anabaena, *Nostoc, Hydrocarbons, Alcohols, Aldehydes, Ketones, Acetone, Butan-2-one, Algae.

The odorous compounds of different strains of Anabaena and Nostoc were identified by gas chromatography and mass spectrometry. The Anabaena and Nostoc strains used produced different patterns of volatile substances including hydrocarbons, alcohols, aldehydes and ketones. A. oscillarioides produced high concentrations of compounds with C8 - skeletons with different substituents and unsaturations. The major compounds were oct-2-en-1-ol, oct-1-en-3-ol, octa-1,5-dien-3-ol and octa-1,trans 3, cis 5-triene. Together with numerous substances found in low concentrations, the two Nostoc strains produced acetone and butan-2-one. Anabaena PCC 7120 and A. flos-aquae produced trace amounts of different odorous compounds. Lack of nor-carotenoids such as beta-ionone, beta-cyclocitral and 6-methylhept-5-en-2-one is pointed out. (Author's abstract)
W84-02278

ISOLATION AND IDENTIFICATION OF ODOUROUS COMPOUNDS FROM A LAKE SUBJECT TO CYANOBACTERIAL BLOOMS,
National Research Council of Canada, Saskatoon, Saskatchewan. Prairie Regional Lab.
G. P. Slater, and V. C. Blok.
Water Science and Technology, Vol. 15, No. 6-7, p 229-240, 1983. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Cyanophyta, *Eutrophication, *Taste, *Odor, *Buffalo Pound Lake, Saskatchewan, Anabaena, Oscillatoria, Aphanizomenon, Geosmin, Beta-cyclocitral.

Buffalo Pound Lake in southern Saskatchewan, Canada, is subject to heavy blooms of blue-green algae, mainly Anabaena, Oscillatoria and Aphanizomenon. The occurrence of any of these species is usually followed by the appearance of pronounced tastes and odors. Water samples were extracted using a Likens-Nickerson or continuous liquid-liquid apparatus and capillary GC of the extracts showed that a large number of compounds are always present although the taste and odor vary in intensity. Many of these compounds have been identified using capillary GC-MS. Geosmin, which imparts a muddy flavor to water, was detected but methylisoborneol was absent. Other compounds present in the water included alkanes, alkylbenzenes, acetophenone, cyclohexanone, phenylacetonitrile, and alpha-pinene, some of which could affect the palatability of the water. Although some water samples had a musty odor, extracts were frequently dominated by a pungent, smoky or tobacco flavor consistent with the presence of beta-cyclocitral which was also indicated by GC-MS. (Author's abstract)
W84-02279

OSCILLATORIA BREVIS (KUTZ.) GOM. AND SOME OTHER ESPECIALLY ODOURIFEROUS BENTHIC CYANOPHYTES IN NORWEGIAN INLAND WATERS,
Norwegian Inst. for Water Research, Oslo.
L. Berglind, I. J. Johnsen, K. Ormerod, and O. M. Skulberg.
Water Science and Technology, Vol. 15, No. 6-7, p 241-246, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Oscillatoria, *Cyanophyta, *Norway, *Odor, Algae, Geosmin, Methyliosborneol, Actinomycetes, Phormidium, Algal mats, Benthic algae.

Obnoxious odors are connected with the growth of the cyanophyte Oscillatoria brevis in benthic algal mats in Norwegian inland waters. Axenic cultures of the O. brevis clone NIVA CYA 7 produced strong muddy smelling compounds, geosmin and 2-methylisoborneol. The correlation between profuse development of benthic cyanophytes and off-flavor problems indicates that these organisms are liable for the effect. The interrelationships between cyanophytes and Actinomycetes in benthic algal growth of inland water (mats of blue-green algae such as Oscillatoria and Phormidium) requires further research. (Moore-IVI)
W84-02280

ODOR PROBLEMS IN LAKE BIWA,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
For primary bibliographic entry see Field 5F.
W84-02284

CHANGES IN TURBIDITY AS A RESULT OF MINERALISATION IN THE LOWER VAAL RIVER,
D. C. Grobler, D. F. Toerien, and J. S. de Wet.
Water South Africa, Vol. 9, No. 3, p 110-116, July, 1983. 7 Fig, 3 Tab, 16 Ref.

Descriptors: *Turbidity, *Mineralization, *Vaal River, *South Africa, Rivers, Water supply, Water quality control, Conductivity, Bloemhof Dam, Prediction.

Highly significant correlations were determined between annual mean values of turbidity (NTU), electrical conductivity (EC) and sodium adsorption ratio (SAR) of the lower Vaal River. A non-linear regression NTU = 1959 - (EC, mS/m) + 9.6 which explained 64% of the variance of turbidity, was derived and can be used for predictions for the lower Vaal River. The extinction coefficient of Bloemhof Dam was related to turbidity according to k = 0.127 (NTU) + 0.55. Thus, the photic zone depth of the lower Vaal River can be predicted for different mineralization (=EC) levels. Future water quality management procedures need this information. (Author's abstract)
W84-02311

MODELING OF THE OXYGEN REGIME OF A FRESHWATER BODY DURING SUMMER HEATING,
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 2I.
W84-02318

COMBINED EFFECTS OF TEMPERATURE AND SALINITY ON CUTTLEFISH (SEPIA OFFICINALIS L.) HATCHING,
CNR, Lesina (Italy). Ist. per la Struttamento Biologica delle Lagune.
G. B. Palmegiano, and M. P. D'Apote.
Aquaculture, Vol. 35, No. 3, p 259-264, 1983. 2 Tab, 14 Ref.

Descriptors: *Fish hatcheries, *Temperature effects, *Salinity, Lagoons, Seasonal variations, Cephalopods, Italy, Lesina lagoon, Cuttlefish, Brackish water.

In an investigation of conditions suitable for achieving commerical production of Sepia officinalis L. in a brackish lagoon by means of egg sowing, the hatching of the eggs of this marine cephalopod were studied under different combined temperatures and salinity conditions. Two series of experiments (3 x 3 and 3 x 2 designs) were run over the temperature range 15-24 degrees C and the salinity range 23-33 0/00 S. Temperature was found to affect only the incubation time, and its relevant regression function is calculated. Salinity had a significant inhibitory effect on hatching at all of the temperatures investigated. No interactive effect between the two parameters was observed. A comparison is made with the results obtained using other temperature and salinity profiles relating to the Lesina lagoon. It is concluded that the environmental conditions occurring in May represent the minimum conditions for obtaining a marketable size harvest in autumn. It is in fact during this period that the lagoon water reaches a temperature of about 20 degrees C and a salinity of 28 0/100, allowing 50% hatching to be achieved in 30 days. (Author's abstract)
W84-02381

TUBIFICIDAE OF THE LITTORAL OF LAKE CONSTANCE, REGARDING ESPECIALLY POTAMOTHRIX MOLDAVIENSIS (DIE LITORALEN TUBIFICIDAE DES BODENSEES MIT BESONDERER BERUCKSICHTIGUNG VON POTAMOTHRIX MOLDAVIENSIS),
For primary bibliographic entry see Field 2H.
W84-02386

EFFECTS OF ACID PRECIPITATION ON EMBRYONIC MORTALITY OF AMBYSTOMA SALAMANDERS IN THE CONNECTICUT VALLEY OF MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
R. P. Cook.
Biological Conservation, Vol. 27, No. 1, p 77-88, 1983. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Acid rain, *Mortality, *Salamanders, Connecticut Valley, Massachusetts, Acidification, Embryos, Ponds, Water pollution effects, Hydrogen ion concentration, Acidity.

The phenomenon of increased embryonic mortality of the spotted salamander Ambystoma maculatum concomitant with breeding pond acidification from acid rainfall was investigated in the Connecticut Valley of Massachusetts. The pH and chemistry of rain and pond water were analysed, and embryonic mortality of spotted and Jefferson salamanders A. jeffersonianum was monitored in 1976 and 1977. Rainfall pH, 4.16 and 4.07 in 1976 and 1977, respectively, indicates that acid rain continues to occur in the area. Ambystoma breeding ponds are acidic, due to background and rainfall acidity. The average pH of six ponds dropped from 5.62 in 1976 to 5.10 in 1977. Pond pH decreased up to 0.75 pH units following heavy rainfall. These trends indicate that pond acidification from acid rain is occurring. Despite pond acidity, embryonic mortality of spotted and Jefferson salamanders was low. For spotted salamanders, mortality ranged from 2.1 to 30.2%, with 15 of 17 ponds below 16%. Embryonic mortality of Jefferson salamanders ranged from 12.4 to 40.3%. No significant correlation between pond pH and percent embryonic mortality was found. Estimates based on numbers of breeding females showed Connecticut Valley spotted salamander populations to be larger than in areas where their decline has been correlated with acid rain. The size of present populations, and the embryonic acid tolerance exhibited by

spotted and Jefferson salamanders, indicate that acid rain has not affected their populations in the Connecticut Valley of Massachusetts. (Author's abstract)
W84-02388

EFFECTS OF ACIDITY OF SIMULATED RAIN AND ITS JOINT ACTION WITH AMBIENT OZONE ON MEASURES OF BIOMASS AND YIELD IN SOYBEAN,
Boyce Thompson Institute, Ithaca, NY.
J. Troiano, L. Colavito, L. Heller, D. C. McCune, and J. S. Jacobson.
Environmental and Experimental Botany, Vol. 23, No. 2, p 113-119, 1983. 5 Tab, 15 Ref.

Descriptors: *Acid rain, *Ozone, *Air pollution, *Soybeans, Biomass, Crop yield, Acidity, Plant growth.

An experiment was performed to determine whether the presence of ozone modified the effects of acidity of simulated rain on growth and yield of soybean (Glycine max) Beeson, a type II cultivar, was grown in field chambers and exposed to simulated rain at 3 levels of acidity, pH 4.0, 3.4 and 2.8. Each level of acidity was applied to plants grown either in unfiltered ambient air or in charcoal filtered (to remove ozone) ambient air. An interaction between acidity of simulated rain and filtration of ambient air on growth and yield was present. The difference in total dry mass between plants grown in filtered and unfiltered chambers increased with increased acidity, of simulated rain treatments. In filtered air, vegetative mass was only slightly decreased with increased acidity, whereas reproductive mass was increased with increased acidity. In unfiltered air vegetative mass decreased with increased acidity but reproductive mass was only slightly decreased at pH 2.8. Components of yield also were differentially affected by acidity, which indicates the need for a better understanding of the sensitivities of different developmental processes of the plant to each kind of pollutant. The apparent interaction between ozone and acidic rain indicates that further investigations on this combination must be conducted before acidic rain effects on plant growth can be accurately assessed in ambient atmospheres. (Author's abstract)
W84-02392

SENSITIVITY RATINGS OF SOILS TO ACID DEPOSITION: A REVIEW,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
W. W. McFee.
Environmental and Experimental Botany, Vol. 23, No. 3, p 203-210, 1983. 1 Fig, 2 Tab, 39 Ref.

Descriptors: *Soil chemistry, *Acid precipitation, *Soil acidification, Acid deposition, Acidification, Atmospheric deposition, Soil classification.

Atmospheric deposition concerns related to soils are mostly associated with nutrient supplying capacity for higher plants and losses through renoff and leaching to aquatic systems. These impacts present a possivliity of serious damage to the soil's ablility to support vigorous plant growth and protect the quality of water. Acid precipitation is so widespread and the potential harm is subtle, so there is a need to concentrate research efforts in areas most likely to be susceptible. One of the difficulties in studying the effects of acidic deposition on soils has been the failure to clearly differentiare between effects of acidic deposition and soil acidification. The latter is an almost ubiquitous process in humid climates. Sources of soil acidity include several natural processes such as nitrification, organic matter decomposition and CO2 production by soil organisms as well as acidic deposition. The acid inputs from ambient atmospheric deposition are 1-2 orders of magnitude smaller than the effects of common agricultural practices such as N fertilization and liming. Soil sensitivity rating systems are compared, and the strengths and theoretical bases of each are discussed. All of the systems were aimed at broad regional mapping and contain many variations within units. They do not define areas where soil damage is occurring, but suggest which soils should be examined first in a search for acidic deposition effects. (Moore-IVI)
W84-02393

IMPACTS OF ACID DEPOSITION ON N AND S CYCLING,
Nebraska Univ.-Lincoln.
R. A. Olson.
Environmental and Experimental Botany, Vol. 23, No. 3, p 211-223, 1983. 4 Fig, 3 Tab, 50 Ref.

Descriptors: *Acid rain, *Soil chemistry, Nitrogen, Sulfur, Acid deposition, Hydrogen ion concentration, Nutrients, Soil acidification, Alkaline soils, Calcareous soils, Agriculture.

Modern concern on the environmental impact of 'acid rain' centers especially on the oxides of N and S. More appropriately expressed as 'acid deposition', the topic has been related largely to impacts on human health and man-made structures with focus only in recent years on possible damage to soils and agricultural production. Likely deleterious effects on soils include reduction in pH, increased activity of various elements with toxicity potential, accelerated mineral weathering and leaching of reserve soil nutrients and undesirable changes in the soil microflora. Areas with greatest potential for soil damage from deposition are in close proximity and downwind from large coal-burning plants, especially where shallow and/or coarse textured soils exist on inaccessible mountainous positions with forest cover. For most of the agricultural regions of this country and the world, however, the N and S fallout products are more beneficial in supplying needed plant nutrients than they are detrimental. Their acidification capacity is insignificant in comparison with that of natural N and S transformations in soils or that induced by conventional fertilizer programs of farmers. The slight acidification imposed over the long term can improve calcareous and alkali soils as growth media and is readily corrected by liming of the acid soils made more acid than desirable or crop production. (Author's abstract)
W84-02394

IMPACTS OF ACID DEPOSITION ON SOIL BIOTA AND C CYCLING,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
D. C. Coleman.
Environmental and Experimental Botany, Vol. 23, No. 2, p 225-233, 1983. 7 Fig, 3 Tab, 37 Ref.

Descriptors: *Acid rain, *Soil chemistry, *Acid deposition, Soil biota, Ecosystems, Tillage, Soil acidity, Acidification, Grasslands, Litter, Forests, Decomposition, Carbon cycling, Primary productivity, Detritus, Soil solution, Nitrogen, Sulfur, Phosphorus, Reviews.

Abiotic and biotic factors in agricultural soils, including range and cropland, are examined in the context of soil biota and carbon cycling. This review looks at a variety of man-managed ecosystems over a range of from minor to major man-managed perturbations. Major emphasis is placed on the results from experimental manipulations of acidity in grasslands and forests and on developing knowledge in zero-till vs. conventional tillage agriculture. In terms of both carbon and energy flow, a majority of the action follows the primary production detritus/decomposer pathway. Certain litter-dwelling organisms and attendant processes, such as litter decomposition, are seriously impacted by decreasing pH. A conceptual model was developed for comparing microbial faunal an plant growth dynamics in conventional vs. no-till situations. The flows indicate breakdown mediated by microbial activity and controlling faunal populations either by direct microbial grazing or predators and top carnivores feeding on the grazers, returning N, P, and S to the soil solution, which is then taken up by plant roots. There are possible inhibiting effects of acid deposition, particularly if the target organisms are concentrated near the soil surface. Further studies in both theoretical and applied ecology are required to answer important questions of stress or effects, such as acid deposition in agro-ecosystems. (Moore-IVI)
W84-02395

IMPACT OF ACID DEPOSITION AND P CYCLING,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
C. V. Cole, and J. W. B. Stewart.
Environmental and Experimental Botany, Vol. 23, No. 3, p 235-241, 1983. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Acid rain, *Acid deposition, *Soil chemistry, *Phosphorus, Nutrient cycling, Agriculture, Ecosystems, Soil erosion, Weathering, Soil management.

The productivity of agricultural soils requires an active cycling of soil P pools through plants and microbial populations. P cycling rates are thus closely linked to transformations of C, N, S and other mineral nutrients. A systems approach to an understanding of factors controlling chemical and biological processes in ecosystems is necessary for an evaluation of the impacts of acid deposition on agricultural soils. Acid deposition effects on P cycling will be most pronounced on soils subject to intense weathering and erosional processes. Management practices developed to relieve these stresses will be most useful in mitigating impacts of acid deposition. (Author's abstract)
W84-02396

IMPACTS OF ACID DEPOSITION ON MICRONUTRIENT CYCLING IN AGRO-ECOSYSTEMS,
Tennessee Valley Authority, Muscle Shoals, AL. National Fertilizer Development Center.
J. J. Mortvedt.
Environmental and Experimental Botany, Vol. 23, No. 3, p 243-249, 1983. 5 Tab, 22 Ref.

Descriptors: *Micronutrients, *Acid rain, *Acid deposition, *Soil chemistry, Soil acidification, Agriculture, Plant nutrients, Hydrogen ion concentration, Buffering capacity, Acid soils, Farming.

Plant availability of all micronutrients except Mo increases with increasing soil acidity. Toxicities due to Mn and Al in extremely acid soils may result in decreased crop yields. Changes in soil pH due to acid depositions are minimal in most agricultural soils because of relatively high buffering capacities of these soils. Modern farming practices such as liming and return of crop residues also may override depositional effects. Therefore, micronutrient cycling in most agro-ecosystems should not be significantly affected by acid depositions. The long-term effects of acid depositions are not known. Plant micronutrients include B, Cu, Fe, Mn, Mo and Zn. Although Cl and Co are also micronutrients, their supply in most agro-ecosystems is usually sufficient. Micronutrient cycling in agro-ecosystems is a complex series of processes involving micronutrient additions to and removal from soils and changes in the chemical forms, solubilities and consequent availabilities of micronutrients to plants induced by changes in the ecosystem. Crop removal and erosion of surface soils result in losses of micronutrients from agricultural soils. Return of crop residues to soils mitigates such losses by returning some of the plant-contained micronutrients and by reducing the potential for erosion. High rates of acid deposition on poorly buffered soils over a period of time may result in measurable changes in soil acidity. Unless a soil is near the critical pH level for Mn or Al toxicity (usually about pH 5.0), soil acidification due to acid precipitation should not have an adverse effect on plant growth. Decreases in soil pH would increase plant uptake of all micronutrients except Mo, but a large fraction of the increased uptake usually would be recycled to soil with the return of crop residues. (Moore-IVI)
W84-02397

IMPACT OF SEDIMENT-ASSOCIATED CONTAMINANTS FROM THE NIAGARA RIVER MOUTH ON VARIOUS SIZE ASSEMBLAGES OF PHYTOPLANKTON,
Canada Centre for Inland Waters, Burlington, Ontario. Great Lakes Fisheries Research Branch.
M. Munawar, A. Mudroch, I. F. Munawar, and R. L. Thomas.

Journal of Great Lakes Research, Vol. 9, No. 2, p 303-313, 1983. 4 Fig, 6 Tab, 25 Ref.

Descriptors: *Sediments, *Phytoplankton, *Water pollution effects, *Niagara River, *Lake Ontario, Bioassays, Metals, Nutrients, Organic compounds, Algae.

The impact of elutriated sediment-associated contaminants from the Niagara River mouth and from a midlake station in Lake Ontario on various size assemblages of natural phytoplankton was determined. The C-14 fractionation bioassays indicated that the addition of Chelex-treated elutriate (without dissolved metals) from the Niagara River mouth enhanced the C-14 uptake when composed to the standard elutriate. Conversely, at the midlake station, the addition of standard elutriate (with dissolved metals) induced higher C-14 uptake from the Chelex-treated elutriate. The synergistic effects of nutrients/metals and metals/organic compounds determine the bioavailability and toxicity of contaminants to natural phytoplankton. The technique is sensitive and useful in detecting the differential response of algal size fractions to contaminants. (Author's abstract)
W84-02419

VARIATIONS OF THE AQUATIC VEGETATION OF THE WELLAND RIVER (ONTARIO, CANADA) ABOVE AND BELOW AN INDUSTRIAL WASTE DISCHARGE,
Brock Univ., St. Catharines, Ontario. Dept. of Biological Sciences.
M. Dickman, C. Prescott, and K. L. E. Kaiser.
Journal of Great Lakes Research, Vol. 9, No. 2, p 317-325, 1983. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Welland River, *Ontario, *Aquatic plants, *Industrial wastes, *Water pollution effects, Effluents, Bioindicators, Typha, Sagittaria, Nitzschia, Cyanophyta, Chlorophyta, Diatoms, Species composition, Conductivity.

The zonation of aquatic macrophytes, particularly Typha and Sagittaria sp. and associated periphyton communities, were investigated in relation to industrial point source discharges to the Welland River, Ontario. Continuous conductivity was consistently higher and more variable downstream of the industrial effluents than upstream, particularly below the Thompson Creek confluence. Zonation of macrophytes in response to waste streams was evident. Immediately downstream of effluent discharges, no macrophytes occurred. Typha was first to return, followed by Sagittaria, and eventually submersed aquatics reinvaded at increased distance (1.6 km) downstream. Size and density of Typha stands also increased with distance from the discharges. The periphyton community also showed alteration in response to waste discharges. Species richness and diversity were lowest immediately downstream of the discharges and increased with distance downstream. Blue-green algae were the dominant forms at all stations, especially at those nearest waste discharges. Filamentous green algae displayed the opposite trend, becoming more common with distance downstream below discharges. Diatoms displayed no consistent trend in response to waste discharges. Replacement of Nitzschia dissipata by N. palea occurred immediately downstream of Thompsons Creek, but not at the other discharge site. (Moore-IVI)
W84-02420

FIELD AND LABORATORY STUDIES OF ENVIRONMENTAL CARCINOGENESIS IN NIAGARA RIVER FISH,
Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black.
Journal of Great Lakes Research, Vol. 92, No. 2, p 326-334, 1983. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Fish diseases, *Polycyclic aromatic hydrocarbons, *Carcinogens, *Niagara River, New York, Toxicity, Bottom sediments, Sediments, Fish, Industrial wastes, Water pollution effects.

The pattern of polycyclic aromatic hydrocarbon (PAH) contamination in a localized segment of the Great Lakes aquatic environment are sufficiently defined to suggest that industrial discharges along the shoreline of eastern Lake Erie and the upper Niagara River near Buffalo, NY have resulted in greatly increased sediment concentrations of these compounds. Field studies of fish tumor pathology have indicated elevated frequencies of neoplastic disease among several species of fish. Laboratory studies have been able to induce epidermal hyperplasia and papillomas as a result of repeated exposure to a complex PAH-containing mixture derived from polluted river sediments. This provides initial evidence linking tumors in some feral fish species to waterborne carcinogenic chemicals present in urban and industrial wastes. (Baker-IVI)
W84-02421

EFFECTS OF ELEVATED THERMAL REGIMES ON SURVIVAL OF RAINBOW TROUT (SALMO GAIRDNERI) ALEVINS,
Ontario Hydro, Toronto. Research Div.
D. W. Rodgers, and J. S. Griffiths.
Journal of Great Lakes Research, Vol. 9, No. 3, p 421-424, 1983. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Thermal pollution, *Trout, *Water pollution effects, *Growth stages, Embryos, Alevins, Mortality, Hatching.

Embryos of fall spawning rainbow trout were incubated and alevins reared under thermal regimes characteristic of ambient winter nearshore Lake Ontario and elevated thermal regimes 2 and 5 C degrees warmer than ambient. Embryos incubated under elevated thermal regimes hatched and attained 50% swim-up sooner than embryos incubated under the ambient thermal regime. In general, mortality of alevins at 21 and 28 days after swim-up was low for all rearing thermal regimes. The generally low mortality of alevins incubated and reared under the various thermal regimes suggests that rainbow trout alevins have fairly broad thermal tolerances when food is provided to excess. (Author's abstract)
W84-02426

CONE-SHAPED HYPOLIMNION AND LOCAL REACTOR AS OUTSTANDING FEATURES IN EUTROPHICATION OF LAKE MARACAIBO,
Estudios y Controles en Contaminacion, Caracas (Venezuela).
G. Parra-Pardi.
Journal of Great Lakes Research, Vol. 9, No. 4, p 439-451, 1983. 13 Fig, 10 Ref.

Descriptors: *Eutrophication, *Hypolimnion, *Lake Maracaibo, *Venezuela, Salinity, Water circulation, Vortex, Anoxic conditions, Nitrogen, Phosphorus, Nutrients, Water temperature, Algae.

Between 1974 and 1979 a large-scale research program to identify and evaluate the pollution problems in tropical Lake Maracaibo (Venezuela) was undertaken. Two unique limnological features investigated during this program were a cone-shaped hypolimnion in the center of the lake and an area of unusually high biologic activity within the northeastern coastal area. The unique cone-shaped hypolimnion exists in the lake as a result of a counterclockwise vortex circulation system. The base of the cone is in the center of the lake bottom and apex is at 5 to 15 m depth. Anoxic conditions, high salinity, and exceedingly high N and P concentrations are found in the hypolimnetic cone. Salinity in the cone is due to intrusion of diluted seawater, which on arriving at the deeper parts of the lake is incorporated into the hypolimnion and slowly dispersed through a process of erosion toward the epilimnion. The saline cone functions as an internal source of nutrients throughout the year at tropical temperatures (29 to 31 C). The plume of Catatumbo River exerts a considerable influence on the general limnoloical features of the lake, isolating the portion in the extreme southern section of the lake. The northeastern coastal area is likened to a biological reactor. Conditions favor accelerated eutrophication, with massive blooms of algae being common. It is characterized as a relatively low energy zone in relation to the horizontal movement of the water in the rest of the lake. (Moore-IVI)
W84-02428

5D. Waste Treatment Processes

MOVEMENT OF BACTERIA AND NUTRIENTS FROM PIT LATRINES IN THE BOUNDARY WATERS CANOE AREA WILDERNESS,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
For primary bibliographic entry see Field 5G.
W84-02136

STABILITY OF COLLOIDS IN AQUEOUS SYSTEMS. THE ROLE OF THE ZETA POTENTIAL AND THE INFLUENCE OF ADSORBED POLYMERS (ZUR STABILITAT VON KOLLOIDEN IN WASSRIGEN SYSTEMEN. DIE ROLLE DES ZETAPOTENTIALS UND DER EINFLUSS ADSORBIERTER POLYMERE),
Agricultural Univ., Wageningen (Netherlands). Dept. of Physical and Colloid Chemistry.
B. H. Bijsterbosch.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 4, p 125 and 127-131, 1983. 10 Fig, 14 Ref.

Descriptors: *Colloids, *Coagulation, *Polymers, *Electrokinetics, Flocculation, Ionic strength, Solutions.

How the interaction forces between two colloidal particles in solution depend on their mutual distance and what influence ionic strength exerts on this interplay are explained. The ensuing picture constitutes the basis of the DLVO-theory of colloidal stability. In the expression for the coagulation concentration that follows from this theory, an important role is played by the diffuse double layer potential. This potential usually can not directly be inferred from experiments and it is thus assumed to be equal to the electrokinetic zeta-potential. The way in which zeta can be obtained from electrophoretic or other electrokinetic experiments is indicated. The presence of polymers in a colloidal system can influence its stability quite markedly. It can as well be enhanced (protection) as be eliminated (flocculation). It appears that the mixing of the components can be crucial in this respect. (Author's abstract)
W84-02140

CARRIER MEDIATED EXTRACTION: APPLICATION OF DOUBLE EMULSION TECHNIQUE FOR MERCURY REMOVAL FROM WASTE WATER,
Academy of Agricultural Sciences, Sofia (Bulgaria). Central Lab. of Chemical Engineering.
L. Boyadzhiev, and E. Bezenshek.
Journal of Membrane Science, Vol. 14, No. 1, p 13-18, June, 1983. 6 Fig, 23 Ref.

Descriptors: *Mercury, *Carrier mediated extraction, *Wastewater treatment, Heavy metals, Waste recovery.

Extraction of mercury(II) cations from low-pH aqueous solutions by means of a double emulsion technique was studied in a laboratory scale, 2 L turbine agitator. A 10% solution of long-chain fatty acids (oleic and linolic) in normal paraffins (C11-C15) was used as the intermediate phase. The optimal operational conditions for fast and complete removal of mercury, providing a 1000-fold concentration increase of the metal in the receiving, encapsulated phase, were obtained. The extraction of mercury at relatively low concentration from wastewater using the double emulsion technique reveals the principle positive features of carrier mediated extraction: fast and efficient removal of the desired species in a single-stage process and reduced consumption of the extracting agent, because only a small quantity of low-concentration organic phase is used. Considering the practical and economical aspects of the problem, this method, with properly chosen operational conditions, could be an efficient tool for large-scale removal and recovery of mercury from wastewaters. (Moore-IVI)
W84-02143

OBSERVATIONS SUPPORTING PHOSPHATE REMOVAL BY BIOLOGICAL EXCESS UPTAKE - A REVIEW,
Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering.
G. V. R. Marais, R. E. Loewenthal, and I. P. Siebritz.
Water Science and Technology, Vol. 15, No. 3/4, p 15-41, 1983. 11 Fig, 45 Ref.

Descriptors: *Activated sludge process, *Phosphorus removal, *Wastewater treatment, Biological wastewater treatment, Anaerobic digestion, Aerobic treatment, Reviews.

The development of the biological excess removal of phosphorus in the activated sludge process is reviewed from 1959 to the present time. Evidence is presented which supports the claim that phosphorus removal is accomplished through biological mechanisms. Even so, the theoretical description, in both a biochemical or bioenergetic sense, is still in a very fundamental stage. The customary black box approach which has dominated developments in this field as well as the application to design and optimization of phorphorus removal plants has probably passed the peak of its usefulness as a research tool. The direction of future research will likely be influenced increasingly by the biochemical aspects of the phenomena. Significant advances in this area will likely come from the greater understanding of the biochemical mechanisms controlling the phenomenon. (Baker-IVI)
W84-02144

FULL SCALE EXPERIENCE WITH PHOSPHORUS REMOVAL IN AN ALTERNATING SYSTEM,
Akvadan-Harvey A/S, Bagsvaerd (Denmark).
E. Bundgaard, G. H. Kristensen, and E. Arvin.
Water Science and Technology, Vol. 15, No. 3/4, p 197-217, April 1983. 9 Fig, 6 Tab, 16 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, Wastewater treatment, Alternating mode of operation, Aerobic conditions, Anoxic conditions, Anaerobic conditions, Nitrates, Nitrites, Oxygen, Sludge, Chemical precipitation, Ferrous sulfate.

Nitrogen removal performed by the alternating mode of operation results in alternating aerobic, anoxic and anaerobic conditions during different operational sequences of the treatment process. Phosphorus release and phosphorus uptake have been observed under the anaerobic and aerobic conditions respectively. Phosphorus release is observed when oxygen, nitrate, and nitrite are absent in the bulk liquid. With oxygen or nitrate present re-uptake of phosphorus is observed. Therefore, information about the dynamic parameter variations in the reactors is considered important in order to optimize the effluent phosphorus quality. Operational results from two treatment plants show enhanced phosphorus removal: 8 mg P/l out of 11 mg P/l in the inlet is removed. Chemical analyses of sludge samples indicate that precipitation of a calcium-iron-phosphate is responsible for the enhanced phosphorus removal. The precipitate constitutes 12% of the total sludge mass. At one treatment plant nitrogen removal is combined with phosphorus removal by simultaneous precipitation with ferrous sulfate. Even in this system phosphorus release and phosphorus uptake is observed, and knowledge about the dynamic parameter variation during the alternating mode of operation can be used to ensure a stable and low effluent phosphorus concentration. (Author's abstract)
W84-02145

PERFORMANCE AND OPERATIONAL ASPECTS OF BIOLOGICAL PHOSPHATE REMOVAL PLANTS IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
B. H. Paepcke.
Water Science and Technology, Vol. 15, No. 3/4, p 219-232, 1983. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Biological wastewater treatment, South Africa, Nitrates, Denitrification, Dissolved oxygen, Entrainment, Sludge.

A survey was undertaken of the operation and performance of eleven multi-stage activated sludge plants in South Africa designated for biological nitrogen and phosphorus removal. The results indicate that phosphorus removal has been consistently good in only one case, although several other plants have performed very well in recent months. The major factors adversely affecting phosphorus removal are excessive amounts of nitrate and dissolved oxygen in the anaerobic basins. Nitrate is introduced into the anaerobic basin in the return activated sludge when denitrification is incomplete. Incomplete denitrification is due to a disproportionately low amount of carbonaceous matter in the influent wastewater relative to the total nitrogen concentration. The dissolved oxygen is the result of air entrainment at the Archimedes screw return activated sludge pumps, at cascades in the influent and return sludge channels, and by vortices caused by the stirrers. Other factors which have significantly affected plant performance are mechanical problems, inadequate operator training, and insufficient sample analyses on which to base operating decisions. With due recognition paid to these problem areas, the performance of future designs should be much improved. (Author's abstract)
W84-02146

PRACTICAL EXPERIENCE WITH BIOLOGICAL PHOSPHORUS REMOVAL PLANTS IN JOHANNESBURG,
A. R. Pitman, S. L. V. Venter, and H. A. Nicholls.
Water Science and Technology, Vol. 15, No. 3/4, p 233-259, 1983. 7 Fig, 13 Tab, 14 Ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Phosphorus removal, *Nitrogen removal, Johannesburg, South Africa, Wastewater facilities, Nitrates, Dissolved oxygen, Load distribution.

Biological phosphorus removal at Johannesburg's two first generation full-scale biological nutrient removal activated sludge plants has not been as successful and easily achieved as one would like. At Goudkoppies, phosphorus removal was fairly good with many periods when effluent levels were well below 1 mg P/l. Performance was erratic with effluent phosphorus peaks often occurring, particularly on Tuesdays. The process sensitivity was largely due to the underloaded nature of the plant and the poor characteristics of the feed sewage. At Northern Works, phosphorus removal was found to be virtually impossible due to the normally grossly underloaded operating conditions. It was only when the load was boosted with primary sludge that this plant removed significant quantities of phosphate. Phosphorus removal was dependent on the maintenance of optimum anaerobic conditions in the first (anaerobic) zone of the process. Optimum anaerobic conditions could be achieved by limiting the input of dissolved oxygen and nitrate to this zone and stimulating a release of phosphate into solution to concentrations in excess of the feed levels. Factors which mitigated against the maintenance of release were the ingress of dissolved oxygen and nitrate via the feed, return sludge or backmixed flow from the first anoxic zone and the low COD in the feed over weekends, holidays and storm periods. In these underloaded plants, phosphorus and nitrogen removal appeared to be in conflict for when oxygen levels were increased to ensure complete nitrification, denitrification was often incomplete, resulting in the backmixing of excessive nitrate the the anaerobic zone and the consequent loss of release. Phosphorus removal and good settling sludges appear to also be in conflict in the plants. (Moore-IVI)
W84-02147

FULL SCALE PHOSPHATE REMOVAL EXPERIENCES IN THE UMHLATUZANA WORKS AT DIFFERENT SLUDGE AGES,
Pinetown Municipality (South Africa)
D. A. Kerdachi, and M. R. Roberts.
Water Sciences and Technology, Vol. 15, No. 3/4, p 261-281, 1983. 5 Fig, 7 Tab, 23 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Biological wastewater treatment, Wastewater treatment, Nitrogen removal, Anaerobic conditions, Acinetobacter, Quasi-plug flow, Retention time, Umhlatuzana Works, South Africa.

The 4.8 Ml/d average dry weather flow, Umhlatuzana Wastewater Treatment Plant was designed to meet the South African General Standard; no special provision for nutrient removal was made in the design, but an extraordinarily high sludge recycle capacity was provided. The removal of high percentages of phosphate was first observed when the plant was operating at a sludge age of 20 days with total anaerobiasis for periods of 10 to 12 hours each day. Full-scale phosphate removal was studied at 69, 38 and 8 day sludge ages. Exceptionally good results were obtained treating an unsettled domestic wastewater in the simple activated sludge plant, under optimum operating conditions in a soft water region. At sludge ages of 69 and 38 days, more than 92% of the influent carbon, nitrogen and phosphorus were removed simultaneously and consistently without chemical addition or tertiary treatment. The success of the method is attributed to predominance of extracellular P-removal mechanism over intracellular mechanisms and to a novel combination of operating features: preliminary conditioning by daily prolonged anaerobiosis; restricted oxygen input and high non-aerobic fraction of process volume; quasi-plug-flow reactor with variable but controlled aerobic and non-aerobic zones; high sludge recycle ratio; and high mixed liquor suspended solids concentration. The low concentration of residual phosphate is probably governed by the equilibrium kinetics of a solid phosphate phase and not by microorganisms. Restricted oxygen input is associated with efficient phosphate removal and it is possible to condition activated sludge anaerobically so that its behavior changes gradually from the anaerobic phosphate release regime associated with luxury uptake by Acinetobacter to a regime of insignificant phosphate release associated with the most efficient phosphate removal. (Moore-IVI)
W84-02148

CONSIDERATIONS IN THE PROCESS DESIGN OF NUTRIENT REMOVAL ACTIVATED SLUDGE PROCESSES,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
G. A. Ekama, I. P. Siebritz, and G. V. R. Marais.
Water Science and Technology, Vol. 15, No. 3/4, p 283-318, 1983. 17 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater composition, *Chemical oxygen demand, *Kjeldahl nitrogen, *Temperature, *Activated sludge process, Phosphorus removal, Nitrogen removal, Denitrification, Biological wastewater treatment, Sedimentation, Oxygen demand.

The average influent wastewater characteristics - (i) the COD concentration, (ii) the TKN/COD concentration ratio, (iii) the rapidly biodegradable COD concentration, (iv) the maximum specific growth rate of the nitrifiers at 20 C attainable in the wastewater, (v) the maximum and minimum temperatures, and (vi) the P/COD concentration ratio - are shown to govern the design of, and effluent quality from single sludge activated sludge processes for both biological nitrogen and phosphorus removal. The TKN/COD ratio governs the selection of the process type: for the Phoredox process, complete denitrification is essential to obtain excess P removal, and this is shown to be feasible only for TKN/COD ratios less than 0.07 to 0.08 mg N/mg COD; as the TKN/COD ratio increases above 0.08, complete denitrification becomes increasingly unlikely, and the UCT or Modified UCT processes are appropriate because in these processes complete denitrification is not essential to achieve P removal - in these processes N and P removal can be traded off against each other depending on the critical nutrient to be removed. Primary sedimentation significantly reduces the biological nutrient removal potential of activated sludge process because it increases the TKN/COD and P/COD ratios and reduces the COD load; however it significantly reduces the

process volume and total oxygen demand. (Author's abstract)
W84-02149

APPLICATION OF ELECTRODIALYSIS WITH ION-EXCHANGE MEMBRANES FOR TREATMENT OF SODIUM SULFATE SOLUTIONS,
Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow.
N. M. Smirnova, B. N. Laskorin, J. S. Michukova, and A. V. Borisov.
Desalination, Vol. 46, p 197-201, May, 1983. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Electrodialysis, *Ion exchange, *Sodium sulfate, *Wastewater treatment, Industrial wastewater, Wastewater renovation, Water reuse, Sulfuric acid, Caustic soda, Brines.

The pilot plant study was carried out and a two-stage electrodialysis process was developed for treatment of industrial waste waters containing sodium sulfate, which guarantees utilization of acid, alkali and reclaimed water. The dialysates are obtained with a salt concentration 2 g/l (90% from feed solution) and the brines with a salt content 260-320 g/l on the first stage during desalination in a multicompartment electrodialyzer from the solutions, which contained about 20-40 g/l of sodium sulfate. Solutions of sulfuric acid and caustic soda with concentration 17-19% by weight are manufactured at the second stage in three-compartment electrodialysis stack from the brine. The highly selective membranes guarantee the content of sodium sulfate in both products less than 1%. (Author's abstract)
W84-02151

DYNAMIC MEMBRANE ULTRAFILTRATION AND HYPERFILTRATION FOR THE TREATMENT OF INDUSTRIAL EFFLUENTS FOR WATER REUSE,
Memphis-Shelby County Human Services Partnership Project, TN.
G. R. Groves, C. A. Buckley, J. M. Cox, A. Kirk, and C. D. Macmillan.
Desalination, Vol. 47, p 305-312, May, 983. 4 Fig, 7 Ref.

Descriptors: *Membrane processes, *Wastewater treatment, Water reuse, Membranes, Ultrafiltration, Reverse osmosis, Hyperfiltration.

The treatment of high strength, highly fouling or hot industrial effluents by conventional membrane technology is difficult. Dynamic membranes are very versatile and have the major advantage of being replaceable in situ. The versatility of dynamic membrane technology is demonstrated. Both the ultrafiltration and reverse osmosis types of technology have several important advantages over conventional membranes for these types of applications. The low to medium salt rejection ultrafiltration dynamic membrane is useful particularly for water recycle applications where limited control of salt build-up is required. The capital cost of dynamic membrane modules is similar to that for thin-film composite tubular reverse osmosis modules. With their inherent advantage of higher membrane fluxes and ability to process both fouling and hot industrial effluents, the economics for certain applications may be favorable. (Baker-IVI)
W84-02156

DESALINATION AND REUSE OF INDUSTRIAL WASTE WATER BY ELECTRODIALYSIS,
Asahi Glass Co. Ltd., Yokohama (Japan). Research Lab.
K. Sato, S. Kobayashi, and S. Okado.
Desalination, Vol. 47, p 363-373, May, 1983. 7 Fig, 4 Tab.

Descriptors: *Electrodialysis, *Wastewater renovation, *Desalination, Industrial wastewater, Wastewater treatment, Water reuse, Pretreatment, Suspended solids, Filtration, Costs, Cooling water, Glass industry.

An economical desalination system for industrial waste water reuse has been developed using electrodialysis. The system consists of pretreatment and electrodialysis sections. With a conventional pretreatment of feed water through a sand filter, an increase of pressure drop in an electrodialyzer and also a decrease of performance of ion-exchange membranes occurred. They resulted from a deposition of suspended solids in a feed water on membranes. A new pretreatment method has been developed by a dual media sand filtration with addition of small quantity of ferric chloride and sodium hypochlolite into a feed water. In a pilot test with a capacity of 0.7 cu m/day, the new pretreatment process was verified to be effective for removing suspended solids below 0.1 ppm, which was corresponded to plugging index (P.I.) below 50%, and it was also proved that the increase of pressure drop in the electrodialyzer was suppressed with the feed of the filtrate. Based on these results, a commercial plant with a capacity of 400 cu m/day was constructed for desalting cooling waste water from a glassware manufacturing plant containing TDS of 500-1000 ppm and 1 - 2 ppm colloidal suspended solids. Since August 1980, the system has been operated successfully with little increase of pressure drop of the electrodialyzers. The power consumption of desalination was 0.15 KWH-DC/cu m-water and the running cost was estimated to be about 33 yen/cu m in case of power cost of 15 yen/KWH. (Author's abstract)
W84-02157

DENITRIFICATION WITH METHANOL; FUNDAMENTAL STUDY OF THE GROWTH AND DENITRIFICATION CAPACITY OF HYPHOMICROBIUM SP.,
Louvain Univ. (Belgium). Inst. voor Industriele Scheikunde.
P. Timmermans, and A. Van Haute.
Water Research, Vol. 17, No. 10, p 1249-1255, 1983. 8 Fig, 6 Tab, 16 Ref.

Descriptors: *Biological wastewater treatment, *Denitrification, *Hyphomicrobium, Nitrification, Methanol, Hydrogen ion concentration, Temperature, Nitrates, Nitrites, Wastewater treatment.

Hyphomicrobium sp. were found as dominant organisms in a two-sludge nitrifying denitrifying wastewater treatment system with methanol as external carbon source. The optimal pH for growth was found to be 8.3 and the organisms seemed to be rather temperature sensitive (Q10 = 3.3). The denitrification rate was expressed as a function of pH and temperature since it was almost independent on the concentrations of methanol and nitrate nitrogen. Identical growth rates are found when using either nitrate- or nitrite-nitrogen; the nitrite consumption rate, however, is twice the nitrate reduction rate. Nitrate to nitrite reduction is the rate limiting step in denitrification reaction and some inhibition by high concentrations of nitrite on the nitrate reduction is measured. The methanol/nitrate N ratio is 2.55 and increasing to 3.5 at extreme pH values. The endogenous denitrification rate is only 10% of the normal denitrification rate measured. (Author's abstract)
W84-02178

NITROGEN REMOVAL IN AERATED LAGOONS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
E. J. Middlebrooks, and A. Pano.
Water Research, Vol. 17, No. 10, p 1369-1378, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater lagoons, *Nitrogen removal, Aerated lagoons, Mathematical models, Hydraulic models, Plug flow, Mixing, Dispersed flow, Kinetics, Detention time.

Rational and empirical models of ammonia nitrogen and total Kjeldahl nitrogen (TKN) removals were evaluated as a means of developing design relationships that can be used to estimate nitrogen removal in aerated wastewater lagoons. Plug flow, complete mix and dispersed flow hydraulic models were evaluated in conjunction with Monod growth kinetics, first order kinetics, and multiple substrate limiting relations. Polynomial equations, and multiple regression analyses were also tried. Combinations of the models were evaluated using field data from five aerated lagoon systems operating in various geographical areas of the USA. Only the plug flow model, assuming first order kinetics, of the classical approaches to biological modeling produced satisfactory results. Because of the simplicity of the plug flow model and a model based on the relationship between the fraction of nitrogen removed and the hydraulic detention time, it was recommended that these two equations be used to estimate nitrogen removal in aerated lagoons. (Author's abstract)
W84-02187

OZONATION OF WATER CONTAINING CHLORINE OR CHLORAMINES; REACTION PRODUCTS AND KINETICS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. R. Haag, and J. Hoigne.
Water Research, Vol. 17, No. 10, p 1397-1402, 1983. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Water treatment, *Disinfection, *Chemical reactions, Ozonation, Ozone, Chlorination, Chlorine, Chloramines, Kinetics, Drinking water, Oxidants.

When ozone and chlorine are applied in combination during water treatment, a direct reaction occurs which consumes both oxidants. This may be helpful for the treatment of wastewaters by using ozone to destroy toxic chlorine or chloramine before discharge into the receiving waters. However, this reaction can also reduce the efficiency of drinking water treatment, if ozonation is followed directly by chlorination or ozonation succeeds chlorination. Ozone reacts with aqueous chlorine at pH greater than 8 with a second order rate constant of 120/M/s at 20 degrees C. In the presence of 1 mg/l of chlorine at pH 8 this corresponds to an ozone half like of about 10 min. The ozonation products of aqueous chlorine are 77% chloride ion and 23% ClO3(-), independent of pH. No ClO4(-) is formed. Because of the low yield of ClO3(-) from chlorine, large amounts of toxic ClO3(-) are not expected to be produced by the ozone-chlorine reaction at a waterwork. The effect of ammonia, via formation of monochloramine, is to decrease the rate constant for ozone consumption to a pH-independent 26/M/s. The products of NH2Cl ozonation are NO3(-) and Cl(-), but not ClO3(-). Reaction of chlorine with ozone accounts for the bulk of the additional chlorine and ozone demand found when the two oxidants are used simultaneously and thus explains to a large degree the interference in the disinfection process. (Baker-IVI)
W84-02190

EFFECT OF SOLUTE COMPETITION ON OZONOLYSIS OF INDUSTRIAL DYES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. M. Saunders, J. P. Gould, and C. R. Southerland.
Water Research, Vol. 17, No. 10, p 1407-1419, 1983. 19 Fig, 6 Tab, 34 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Dye industry wastes, Solutes, Ozone, Oxidation, Dyes.

Ozonation of three industrial dyes was examined in batch studies with single- and multi-solute dye solutions. The kinetics of dye oxidation were controlled by gas transfer limitations and oxidation took place at the gas-liquid interface. Competition by dye molecules for the gas-liquid interface and relative chemical reactivity resulted in the preferential oxidation of selected dyes in mixtures of three dyes and auxilliary compounds typically found in dye-bath wastewaters. These findings suggest that surface-active properties of wastewater contaminants may be as important as their chemical reactivity in determining the overall fate of contaminants during ozonation. Ozonation of wastewater samples in a laboratory scale heterogeneous gas flow system may not be indicative of the

results that would be obtained in full-scale reactor system if the ozone transfer characteristics of the two systems are significantly different. If the preferential oxidation of compounds at a gas-liquid interface was decreased in overall importance by enhanced ozone transer and accumulation of a residual ozone concentration in solution, then the sequence of compound oxidation and resulting oxidation-product distributions would be potentially altered. Increased ozone requirements could result if significant oxidation of contaminants other than target compounds was achieved concurrently with the oxidation of the target compounds. (Baker-IVI)
W84-02191

EVALUATION OF ALTERNATIVE SLUDGE SETTLEABILITY INDICES,
Merck and Co., Inc., Rahway, NJ.
S.-E. Lee, B. Koopman, H. Bode, and D. Jenkins.
Water Research, Vol. 17, No. 10, p 1421-1426, 1983. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Sludge, Suspended solids, Sludge volume index, Settling, Sludge thickening, Water pollution control, Clarifiers, Clarification.

The unpredictable effect of suspended solids (SS) concentration on the standard solids volume index (SVI) is widely recognized. Five modifications of the SVI test were evaulated in attempts to overcome this problem. The five different indices tested were diluted SVI, SVI annd SS concentrations of 1.5, 2.4, and 3.5 g/l, and stirred SVI at 2.5 g/l. The closest and most consistent correlation with filamentous organisms content was the diluted SVI modification. Its consistent behavior derives from always having the compact volume of the settled sludge measured after the compression phase of settling is reached. Convenience is preserved in this modification by diluting the sludge so that the compression phase of settling is reached within a 30-min period. Other advantages of this test include a wider range of settleabilities over which sludges may be characterized and applicability to bench scale units as well as to prototype scale plants in terms of the quantity and concentration of sludge required to perform the test. Correlation of the diluted SVI with specific functional relationships between settling velocity and SS concentration would enable the application of this parameter to prediction of thickening capacity in secondary clarifiers. (Baker-IVI)
W84-02192

PREDICTION OF THICKENING CAPACITY USING DILUTED SLUDGE VOLUME INDEX,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
B. Koopman, and K. Cadee.
Water Research, Vol. 17, No. 10, p 1427-1431, 1983. 8 Fig, 1 Tab, 8 Ref. Univ. of Florida Grant 124516191.

Descriptors: *Wastewater treatment, *Activated sludge process, *Sludge thickening, Water pollution control, Secondary wastewater treatment, Sludge volume index, Clarifiers, Biological wastewater treatment.

Knowledge of the secondary clarifier's capacity to produce an adequately thickened underflow stream is essential for successful design and control of the activated sludge process. How sludge settleability, as characterized by diluted sludge volume index (SVI*) can be factored into thickening capacity calculations is demonstrated. From considering of published data relating activated sludge settling velocity to filament content and suspended solids concentration and SVI* to filament content it was shown that parameters characterizing activated sludge settling properties were consistently related to SVI*. These correlations were used in conjunction with settling flux theory to demonstrate limiting solids loading plotted as a function of SVI* and underflow velocity. Applications of this information include determination of limiting solids loading, minimum underflow velocity, return sludge pumping capacity, and maximum possible mixed liquor suspended solids concentration. (Baker-IVI)
W84-02193

PREDICTIVE MODEL FOR TREATMENT OF PHENOLIC WASTES BY ACTIVATED SLUDGE,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, A. F. Gaudy, Jr., and P. D. D'Adamo.
Water Research, Vol. 17, No. 10, p 1453-1466, 1983. 8 Fig, 9 Tab, 28 Ref. OWRT project A-051-DEL.

Descriptors: *Wastewater treatment, *Activated sludge processes, *Phenols, Industrial wastes, Model studies, Monod equation, Haldane equation, Oxygen demand, Kinetics.

A kinetic model for activated sludge treating inhibitory wastes has been devised and tested experimentally using phenol as inhibitory carbon source. The model employs the Haldane equation as the functional relationship between specific growth rate, and exogenous substrate concentration and utilizes control of recycle sludge concentration as a major selectable engineering control parameter of net specific growth rate. Predictions of process performance were made using the model equations and the five biokinetic constants determined from the pilot plant data and from separate batch growth experiments. The model adequately predicted reactor biomass concentration, waste sludge production and effluent COD concentration. The model predicted specific phenol concentrations in the reactor effluent significantly higher than the observed experimental values. The results of the growth studies clearly indicate that the Monod equation was note generally applicable to phenol. Also, dilute-out curves computed using the biokinetic constants, recycle sludge concentration and recycle flow rate employed in the pilot plant studies clearly showed that the two approaches (Haldane and Monod) predict radically different results as dilution rate increases. At high concentration levels of the substrate in inflowing feed to the biological reactor the inhibitor model clearly indicated system failure at dilution rates significantly lower than predicted by the Monod model. The use of a Monod function in the mass balance equations gives both the design engineer and the operator a distorted view of the true operating range of the system and does not alert one to the existence of a critical operating point for an activated sludge process treating inhibitory carbon sources. (Baker-IVI)
W84-02196

EFFECT OF SANITATION EFFORTS ON THE MANGANESE CYCLE IN LAKE CONSTANCE (OBERSEE AND UNTERSEE-GNADENSEE) (DIE AUSWIRKUNGEN VON SANIERUNG-MASSNAHMEN AUF DEN MANGANHAUSHALT DES BODENSEES (OBERSEE UND UNTERSEE-GNADENSEE)),
Landesansalt fur Umweltschutz Baden-Wuettemberg, Langenargen (Germany, F.R.). Inst. fur Seenforschung und Fishereiwesen.
For primary bibliographic entry see Field 5C.
W84-02242

REMOVAL AND INACTIVATION OF VIRUSES BY TREATMENT PROCESSES FOR POTABLE WATER AND WASTEWATER-A REVIEW,
Montgomery (James M.), Inc., Pasadena, CA.
L. Y. C. Leong.
Water Science and Technology, Vol. 15, No. 5, p 91-114, 1983. 15 Tab.

Descriptors: *Viruses, *Bacteriophage, *Wastewater treatment, *Water treatment, *Water reuse, Disinfection, Potable water, Chlorination, Wastewater renovation, Public health.

Due to increasing urbanization, developing economical uncontaminated water sources is becoming more difficult. The resultant increase of indirect reuse and proposed and operating reuse projects raise questions concerning the public health hazard from waterborne viruses. A review of the fate of enteric viruses and phages through each major unit process used in wastewater and potable water treatment is given. Starting out with raw sewages, optimized conventional tertiary wastewater treatment with one hour contact and free chlorine residuals can be expected to remove 5-7 logs of viruses leaving <1 infectious unit/1000 liters. The most consistent and conservative potable water treatment designs dictate that one relies on good water resources and utilizes renovated waters in manners which give the least direst exposure to the public. Dilution, indirect reuse, or additional treatment are the suggested approaches until more research is conducted. This would minimize the public health problems and provide a buffer for viruses and other contaminants which have yet to be detected and identified or for those which may occasionally break through the treatment train. It is difficult to design and operate a failsafe drinking water plant. Therefore, direct reuse should be utilized for short periods of time or under special circumstances. (Moore-IVI)
W84-02262

EVALUATION OF THE LOAD OF ENTEROVIRUSES IN A BIOLOGICAL WASTEWATER TREATMENT PLANT,
Laboratoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre Les Nancy (France). Faculte de Medecine.
D. Rolland, Ph. Hartemann, J. C. Joret, A. Hassen, and J. M. Foliguet.
Water Science and Technology, Vol. 15, No, 5, p 115-121, 1983. 1 Fig, 4 Tab, 17 Ref.

Descriptors: *Enteroviruses, *Biological wastewater treatment, *Activated sludge process, Sampling, Automation, Bacteria, Indicators, Wastewater treatment, Nancy, France.

The numbers of enteroviruses, classical bacterial indicators and physicochemical parameters were recorded for raw and treated wastewaters from the Nancy (France) activated sludge treatment plant, over 24 and 72 hours periods. Sampling was performed manually by collection of 2 and 3 hour interval dip samples and by sequential automatic samplers. The results obtained with both methods are in good agreement; 24 hours composite samples with automatic sampling are representative of enteroviruses flux and thus allow studies of the efficiency of removal treatments. According to both sampling methods, the efficiency of the Nancy wastewater treatment plant is about 84% for the removal of indigenous enteric viruses. (Author's abstract)
W84-02263

VIROLOGICAL STUDY OF DRINKING AND WASTEWATER DISINFECTION BY OZONATION,
Laboatoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre les Nancy (France). Faculte de Medecine.
For primary bibliographic entry see Field 5F.
W84-02266

BIOMETHANATION BY IMMOBILISED FLUIDISED CELLS,
Louvain Univ. (Belgium). Unit of Bioengineering.
R. A. Binot, T. Bol, H.-P. Naveau, and E.-J. Nyns.
Water Science and Technology, Vol. 15, No. 8/9, p 103-115, 1983. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Fluidized beds, Anaerobic conditions, Industrial wastes, Bacteria, Biomethanation.

High loading rates and high conversion rates can be obtained in biomethanation of industrial wastewaters by accumulating active biomass in anaerobic reactors. A particular technique of active biomass accumulation, using cell immobilization on inert solid support particles fluidized in an upflow reactor, is presented. The results obtained in a lab-scale reactor of 0.5 l total volume, using spent liquor from citric acid fermentation, are good. Volumetric loads up to 42,000 mg COD/l reactor/day with more than 70% conversion are reached under steady state conditions and volumetric load increases of 10% per day with stable conversion are feasible during transition steps.

Loading and conversion rates are drastically higher in immobilized fluidized cell systems than in conventional completely mixed systems, with similar food to microorganism ratios and gas production rates per active biomass unit in the reactor. These performances are directly related to the accumulation of active biomass, including methanogenic bacteria, in immobilized fluidized cells reactors. A more qualitative approach is used to compare the immobilized fluidized cell technique with other active biomass accumulation techniques. (Baker-IVI)
W84-02285

ANAEROBIC FILTER TREATMENT OF MOLASSES FERMENTATION WASTEWATER,
Universidade Nova de Lisboa, (Portugal). Dept. of Environmental and Earth Science.
M. J. T. Carrondo, J. M. C. Silva, M. I. I. Figueira, R. M. B. Ganho, and J. F. S. Oliveira.
Water Science and Technology, Vol. 15, No. 8/9, p 117-126, 1983. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Food-processing wastes, *Filtration, Anaerobic conditions, Fermentation, Sulfides, Hydrogen sulfide, Wastewater treatment.

Two anaerobic filters were used to assess the treatability of a high strength acidic molasses fermentation wastewater containing up to 3000 mg/l of sulfate ion. The waste had to be neutralized and buffered prior to treatment and the filters operated at ambient temperature. The inlet COD concentrations were increased from 10,000 to 50,000 mg/l, organic loads ranged from 2 to 12 kg COD/cu m per day at hydraulic retention times of 2.5 and 5 days. COD removals varied from 57 to 79% and removal rates as high as 6.8 kg COD/cu m per day were obtained. Although the gas productions were reasonable, the methane content was always lower than 40%. Anaerobic filters appear to be good for pretreatment purposes and the gas produced may be used for burning with some caution due to high sulfide concentrations. Alternatively, the sulfide might be precipitated or scrubbed off. Although the alkalinity gains are small, it is probably important to recycle the effluent to decrease the costs associated with the chemicals used for neutralizing the influent. The use of two filters in series might further improve the treatment results. The filters were operated for seven months without sludge removal. (Baker-IVI)
W84-02286

INDUSTRIAL WASTEWATER TREATMENT USING ANAEROBIC FLUIDIZED BED REACTORS,
Ecolotrol, Inc., Bethpage, NY.
J. S. Jeris.
Water Science and Technology, Vol. 15, No. 8/9, p 169-176, 1983. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Fluidized beds, Anaerobic conditions, Industrial wastes, Methane, Energy, Activated sludge process, Biological wastewater treatment.

Pilot plant results of anaerobic treatment using granular biological fluidized bed treatment for a number of industrial wastes are presented. Wastes containing from 5,000 to 54,000 mg/l were treated with 65 to 95% COD removal in 0.3 to 4.9 days hydraulic detention time. Organic loadings of 3 to 38 kg COD/cu m per day were used. Typically 0.4 l methane were produced per gram of COD removed at 35 degrees C. Methane averaged close to 70% with a range between 65 and 75%. An estimate is given of a simplified energy comparison of anaerobic versus aerobic treatment for a wastewater flow of 100,000 gpd with 5,000 mg/l COD retention and due to the methane generation a net energy production of 2,300 kwh/day is indicated anaerobically versus a net energy use of 600 to 900 kwh/day for the aerobic system. (Baker-IVI)
W84-02287

DESIGN OPERATION AND ECONOMY OF ANAEROBIC TREATMENT,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga, S. W. Hobma, L. W. Hulshoff Pol, W. de Zeeuw, and P. de Jong.
Water Science and Technology, Vol. 15, No. 8/9, p 177-195, 1983. 6 Fig, 6 Tab, 35 Ref.

Descriptors: *Wastewater treatment, *Anaerobic conditions, Activated sludge processes, Filtration, Films.

A more optimal design and operation of a high rate anaerobic waste water treatment process was sought. The discussion is based on available information on modern anaerobic waste water treatment processes, such as the anaerobic filter process and the upflow anaerobic sludge blanket process and of the recently introduced attached film processes. In upflow anaerobic waste treatment processes the presence of packing material in the anaerobic reactor may be beneficial for reducing the washout of suspended matter, but it does not improve the loading potentials of the process due to clogging, shortcircuiting and/or poor contact between the sludge and the waste water that prevails. A prerequisite for using such a process is that a dense, and preferable a granular, type of sludge develop in the anaerobic reactor on the waste water submitted to the treatment process. Once the anaerobic process can be satisfactorily immobilized, high organic and hydraulic loads can be theoretically applied. However, in all cases, the reactor should be equipped with a gas-solids separator. (Baker-IVI)
W84-02288

MATHEMATICAL MODELING OF THE ANAEROBIC FILTER PROCESS,
Royal Inst. of Technology, Stockholm (Sweden). Center for Environmental Sciences.
M. Lindgren.
Water Science and Technology, Vol. 15, No. 8/9, p 197-207, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Mathematical models, *Filtration, *Anaerobic conditions, Wastewater treatment, Biological treatment, Model studies, Monod kinetics, Kinetics, Simulation.

A dilute synthetic wastewater was anaerobically treated in a filter. A relatively complex mathematical model describing the anaerobic degradation of organic carbon and nitrogen in anaerobic filters, as a two-step process, adequately simulates steady state data. The model is based on Monod-kinetics incorporating a pH inhibition function but neglecting solids transport and biofilm diffusion. The model accurately describes the chemical interactions occurring in the filter among nitrogen, volatile acids, carbon dioxide, alkalinity and pH and is very useful for system understanding. A simplified model based on first and zero order kinetics and separate biosolid fractions also adequately simulates steady-state data. This model may be further simplified and is more readily usable for dynamic system analysis, optimization and design. (Baker-IVI)
W84-02289

ANAEROBIC WASTE WATER TREATMENT IN A CARRIER ASSISTED SLUDGE BED REACTOR,
AB Sorigona, Staffanstorp, (Sweden).
L. Martensson, and B. Frostell.
Water Science and Technology, Vol. 15, No. 8/9, p 233-246, 1983. 9 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Sludge bed reactor, Food-processing wastes, Anaerobic conditions, Activated sludge process.

A 40 l tank reactor, filled to 3% (v/v) with a small size (5-25 micrometer) carrier material and equipped with a mechanical mixer, was used to create a sludge bed system for anaerobic wastewater treatment. Solids leaving the tank with the effluent were recycled to the tank from an external settler. Two different substrates were used, fodder molasses diluted with tap water and beet sugar factory wastewater. Influent concentrations were 9.3 g COD/l and 4-7 g COD/l respectively, and treatment was performed at 35-37 degrees C. With the synthetic molasses waste water, an organic load of 5-6 kg COD/cu m/day could be tolerated; with the sugar industry waste water, 25 kg COD. The difference in loading capacity was ascribed to different types of sludges formed, the molasses waste water resulting in a much more bulky sludge and a lower attainable volatile suspended solids concentration. Much care must be exercised before designing sludge bed systems for high loads with unhydrolyzed waste waters. With the sugar industry wastewater, a food-to-mass ratio of 1.3 kg COD/kg VSS/day resulted in an efficient treatment. For the molasses substrate, problems were encountered at food-to-mass ratios exceeding 0.5-0.7 kg COD/kg VSS/day. Sludge bed reactors seem to have their greatest potential for hydrolyzed wastewaters. (Baker-IVI)
W84-02290

ANAEROBIC TREATMENT OF A BLACK LIQUOR EVAPORATOR CONDENSATE FROM A KRAFT MILL IN THREE TYPES OF FIXED-FILM REACTORS,
Swedish Water and Air Pollution Research Lab., Stockholm.
J. Norrman.
Water Science and Technology, Vol. 15, No. 8/9, p 247-259, 1983. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Anaerobic digestion, *Kraft mills, *Pulp wastes, Wastewater treatment, Methane, Sulfates, Pulp and paper industry, Industrial wastes.

A black liquor evaporator condensate from a kraft mill was anaerobically treated in a fixed bed reactor (= an anaerobic filter), an expanded bed and a fluidized bed. The condensate treated in the fixed bed reactor and the expanded bed had an average COD concentration of 1.4 kg/cu m. Before treatment in the fluidized bed the condensate was diluted to 0.42. Efficient purification (80 % COD reduction or better) was obtained at volumetric loads up to 2 kg COD in the fixed bed reactor, 10 kg COD/cu m/d in the expanded bed and 13 kg COD/cu m per day in the fluidized bed. Two of the reactors were operated at room temperature. When the temperature dropped below 20 degrees C gas production was inhibited. The specific methane production was 0.10-0.30 cu m/kg COD added in the fixed bed reactor, 0.07-0.15 cu m/kg COD added in the expanded bed and 0.07-0.20 cu m/kg COD added in the fluidized bed. Process stability was high in both the fluidized bed and the fixed bed reactor, but sand and biomass were intermittantly lost from the expanded bed. (Baker-IVI)
W84-02291

ATTACHED VERSUS SUSPENDED GROWTH ANAEROBIC REACTORS: RESPONSE TO TOXIC SUBSTANCES,
Drexel Univ., Philadelphia, PA.
G. F. Parkin, and R. E. Speece.
Water Science and Technology, Vol. 15, No. 8/9, p 261-289, 1983. 18 Fig, 4 Tab, 27 Ref. DOE contract EC-77-S-02-4391, USAF contract F-49620-79-C0190, NSF contract NSF-ENG-79-07993.

Descriptors: *Anaerobic digestion, *Methane fermentation, Cyanide, Chloroform, Formaldehyde, Ammonia, Fermentation, Methane, Industrial wastes, Toxicity, Nickel, Sulfides, Energy, Methanogens, Wastewater treatment.

Anaerobic methane fermentation has significant potential for treatment of industrial wastewaters. Application of the process has been limited, due in part to the belief that the process cannot tolerate chronic and transient toxicity inherent in many industrial wastewaters. A comparison was made of the response to transient and chronic toxicity of suspended and attached growth reactors. Experiments with cyanide, chloroform, formaldehyde, ammonium, nickel and sulfide have shown that the methanogens have the ability to recover from and acclimate to relatively high concentrations of toxicants and that prolonged periods of zero gas production are not indicative of actual or eventual

process failure. The key is proper attention to solids retention time. Of the two general reactor types used in biological waste treatment, attached growth systems offer two major potential advantages over suspended growth systems for treating wastewaters containing toxicants: higher inherent solids retention times at relatively low hydraulic retention times and the potential for a quasi plug-flow hydraulic regime that allows rapid elution of toxicants. For transient toxicity, the ability of a plug-flow, attached growth systems to rapidly elute toxicants resulted in dramatically reduced down times when compared to a complete-mix, suspended growth system. For chronic toxicity, the solids retention capability of attached growth systems allows for acclimation to occur prior to washout of active biomass. Effluent recycle to plug-flow, attached growth systems should allow for more gradual exposure to chronic toxicity, thus maximizing acclimation potential. (Baker-IVI)
W84-02292

DISTURBANCE OF SAND FILTER SUPPORTING LAYERS BY AIR SCOURING,
Geustyn Forsyth and Joubert, Inc., Pretoria (South Africa).
J. Haarhuff, and W. M. Malan.
Water South Africa, Vol. 9, No. 2, p 41-48, April, 1983. 5 Fig, 6 Ref.

Descriptors: *Sand filters, *Air scouring, *Backwash, Gravel, Design criteria, Cleaning.

The backwashing of rapid sand filters and in particular the method whereby the filter bed is subjected to a period of scouring with air alone before the impurities are flushed from the bed with a low velocity backwash, is reviewed. This widely used method displayed the potential to disturb the gravel layers on which the sand is supported if the air scour rate exceeds a certain value. Experimental work is reported which indicates when, how and under which circumstances the gravel particles intermix with the sand. At an equivalent air scour rate of 8.7 mm/s a few gravel particles at the top of the fine gravel layer were just lifted in the sand above as the first burst of air rose through the bed. Preliminary design parameters are proposed to prevent the intermixing of sand and gravel. The serious consequences of this intermixing are outlined and a few of the many possible solutions are briefly evaluated including abolition of the sand supporting layers, keeping the design air scour rate below the critical value, using a reduced air scour rate at the start of the air scour cycle and using double reverse gravel grading. (Baker-IVI)
W84-02303

TRACE METAL SURVEYS IN MOSSEL BAY, ST. FRANCIS BAY AND ALGOA BAY, SOUTH AFRICA,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water South Africa, Vol. 9, No. 2, p 57-65, 1983. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Trace metals, *Coastal waters, South Africa, Papenkuils River, Cape Recife, Mossel Bay, St. Francis Bay, Algoa Bay, Swartkops River, Monitoring, Water pollution.

Surveys to determine trace-metal levels in Mossel Bay, St. Francis Bay and Algoa Bay were undertaken during 1978-1979. Water, sediment and biological samples were analysed for up to 16 elements by atomic absorption spectrophotometry. Metal concentrations are low along the entire Mossel Bay coast and no significant sources of metal pollution were discovered. Some variations in concentrations occur but these are often due to catchment mineralization and, in any case, are only slightly elevated above background levels. St. Francis Bay is unpolluted with respect to metals, the levels of which are generally lower than those found in equivalent samples from Algoa Bay. The Swartkops and Papenkuils Rivers and the Cape Recife sewer outfall contribute considerable amounts of metals to Algoa Bay. However, with the exception of the Papenkuils River, these amounts are too small to cause significant environmental stress to the Algoa Bay ecosystem. The diverse fauna and flora of the bay are indicative of an unpolluted environment. (Author's Abstract)
W84-02305

APPLICATION OF A TETRAHYMENA PYRIFORMIS BIOASSAY SYSTEM FOR THE RAPID DETECTION OF TOXIC SUBSTANCES IN WASTEWATERS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W84-02307

GENERALIZED MODEL OF AEROBIC BIOLOGICAL TREATMENT,
V. A. Vavilin.
Water Resources, Vol. 9, No. 4, p 416-427, July-August 1982. 7 Fig, 2 Tab, 23 Ref. Translated from Vodnye Resursy, No. 4, p 136-148 July-August 1982.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Biological wastewater treatment, Model studies, Aeration, Chemical oxygen demand, Biochemical oxygen demand.

A generalized model of the process of aerobic biological treatment, regardless of the type of reactor (aeration tank, biofilter or biodisk), is proposed, based on the following main principles. Reactors accomplishing the process of aerobic biological treatment rework a certain spectrum of substrates-pollutants which represent individual components of a multicomponent pollutant. The rate of treatment depends on the rate of oxidation of individual components and contribution of these rates to the total rate of oxidation, determined by the concentration of components. The main variable determining the law obeyed by the treatment process is the concentration of pollutant in the effluent. For most variations in the effluent pollutant concentration, generalized models of the treatment process are adequate for experiments. The type of reactor as a first approximation is not significant when treating multicomponent wastewaters, since during treatment 0-th order reactions play the dominant role during oxidation of individual components of the multicomponent pollutant. (Baker-IVI)
W84-02325

HYDRODYNAMICS OF TWO-PHASE COCURRENT DOWNFLOW THROUGH PACKED BEDS; PART I. MACROSCOPIC MODEL, PART II. EXPERIMENT AND CORRELATIONS,
Indian Inst. of Tech., Madras. Dept. of Chemical Engineering.
V. G. Rao, M. S. Ananth, and Y. B. G. Varma.
Journal of Hydrology, Vol. 29, No. 3, p 467-483, May, 1983. 23 Fig, 1 Tab, 46 Ref.

Descriptors: *Packed beds, *Pressure distribution, Hydrodynamics, Model studies, Bubbles, Wastewater treatment, Design criteria.

Pressure drop and liquid saturation are two important design parameters in cocurrent gas-liquid downflow through packed beds. A macroscopic model based on momentum balance is formulated for the condition of no radial pressure gradients. The formulation is generalized, the assumptions are explicity stated and an attempt has been made to take into account the interaction between the phases through bubble formation, breakage, and reformation. The model presents a logical framework for the inclusion of other dynamic interactions such as friction at the interface and entrainment and is therefore more comprehensive than earlier models. The model parameters are determined independently for each of the identified regions of flow. However, a priori values are provided for five parameters out of nine on physical grounds, as well as orders of magnitude values for the remaining four. Actual values for these four have to be determined by fitting experimental data to the theory. (Baker-IVI)
W84-02349

CARE AND FEEDING OF A CHEMICAL FEEDER,
R. J. Baker, and W. B. Heuber.
Water Engineering and Management, Vol. 130, No. 12, p 27-28 and 51, November, 1983.

Descriptors: *Chemical treatment, *Maintenance, Waste treatment, Water treatment, Training, Design criteria, Safety, Management.

There are five well defined areas of responsibility for the proper operation and maintenance of a chemical feed system for water or wastewater treatment: the manufacturer of the equipment, the engineer who designs the plant, the chemical supplier, the management of the plant, and the operator who runs the plant. The manufacturer must be able to provide good service and make the equipment correctly. The design engineer must ensure that his design accomodates the needs the system is to provide for and that it does so efficiently and effectively. The chemical supplier must ensure that his product meets the material specification consistently. Plant management must be committed to a permanent, comprehensive operations and maintenance program. The operator has to be trained to supply the operational and maintenance needs of the total system. Also needed are an efficient maintenance schedule, a spare parts inventory, a system for rotating the use of spare or standby equipment, a safety consciousness, and good housekeeping. (Baker-IVI)
W84-02367

EXPENSIVE DISCHARGES FROM CANNERY ROW,
SRI International, Menlo Park, CA. Chemical Engineering Lab.
J. L. Jones.
Water Engineering and Management, Vol. 130, No. 12, p 33-34 and 38, November, 1983. 4 Fig, 2 Tab.

Descriptors: *Canneries, *Wastewater treatment, *Economic aspects, Costs, Food processing wastes, Industrial wastes.

Charges by municipalities for the treatment of seasonal cannery wastewaters are determined by a number of factors, the important ones being the effluent limitations imposed on the treatment plant, the size of the canning season, biochemical oxygen demand, and suspended solids loads relative to the non-canning season loads, the total capacity of the treatment plant, and the treatment processes employed. The wastewater treatment problem has been particularly troublesome to the canning industry because of the magnitude of the waste load. The estimated annual charges for a typical cannery discharging to various municipal sewer systems indicates a sevenfold range in charges from a high of about $360,000 to a low of $50,000 ($3/1000 gal treated to $0.40/1000 gal treated). (Baker-IVI)
W84-02369

MASS BALANCE OF HEAVY METAL UPTAKE BY ENCAPSULATED CULTURES OF KLEBSIELLA AEROGENES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Rudd, R. M. Sterritt, and J. N. Lester.
Microbial Ecology, Vol. 9, No. 3, p 261-272, 1983. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Klebsiella, *Heavy metals, *Activated sludge process, Polymers, Encapsulated cells, Mass balance, Wastewater treatment, Copper, Cadmium, Cobalt, Nickel, Manganese, Metals, Extracellular polymer.

Dialysis was employed as a method of speciating heavy metals in cultures of an extracellular polymer forming strain of Klebsiella aerogenes. A noncapsulated strain of the same bacterium was used as a control, and a mass balance of copper, cadmium, cobalt, nickel, and manganese in batch culture at pH 4.5 and pH 6.8 and in continuous culture at pH 6.8 was constructed. Copper and cadmium were accumulated by the cell during rapid proliferation whereas all 5 metals were bound nonspeci-

fically by extracellular polymer produced during stationary phase and at low dilution rates. The presence of extracellular polymer appeared to inhibit cellular uptake of nickel. At the lower pH, metal uptake was considerably reduced. Capsulated cells of K. aerogenes are capable of retaining greater concentrations of metals than an equivalent number of noncapsulated cells, and although only a fraction of some of the metals added was retained, in comparison to typical environmental concentrations such metal removals may be of considerable significance in the activated sludge process of sewage treatment. (Moore-IVI)
W84-02373

5E. Ultimate Disposal Of Wastes

REDUCTION OF NITRATE CONCENTRATION IN DRINKING WATER BY A HYBRID PROCESS WITH ZERO DISCHARGE BASED ON REVERSE OSMOSIS,
For primary bibliographic entry see Field 5F.
W84-02154

HYDRAULIC DELIQUORING OF COMPRESSIBLE FILTER CAKES. I. REVERSE FLOW IN FILTER PRESSES,
Houston Univ., TX. Dept. of Chemical-Petroleum Engineering.
F. M. Tiller, and L.-L. Horng.
AIChE Journal, Vol. 29, No. 2, p 297-305, March, 1983. 13 Fig, 2 Tab, 20 Ref.

Descriptors: *Dewatering, *Filtration, Porosity, Sludge drying, Sludge thickening, Filters, Wastewater treatment.

Deliquoring of filter cakes is an important operation in solid-liquid separation. Mechanical squeezing using membranes in filter presses requires additional investment in equipment and direct use of hydraulic pressure as developed by pumps represents the simplest method for porosity reduction. Reversing the direction of flow through the highly compressible bed leads to marked reduction in porosity. In filter presses, washing automatically leads to a reverse flow pattern. Failure to recognize the effects of hydraulic, reverse flow deliquoring can negate the practical advantage in an industrial filter. If the expressed liquid is not drained but is simply dumped along with the cake into a common receiver, the average liquid context will remain unchanged. Highly compressible cakes derived from wastewater are seldom washed to removed soluble substances. Therefore, presses used for such filtration must be modified to permit washing if hydraulic deliquoring is to be used. Theoretical calculations are shown for materials with differing characteristics. Experimental verification of the theory is provided for calcium carbonate, kaolin, attapulgite, and colloidal silica. The amount of liquid which could be expressed hydraulically varies from 10-60% of the amount remaining at the end of filtration. (Baker-IVI)
W84-02350

LEACHATE RECIRCULATION PROJECT,
Town of Brookhaven, Patchoque, NY. Division of Sanitation.
J. W. Pavacic.
Public Works, Vol. 114, No. 5, p 68-70, May, 1983. 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Leachates, *Landfills, Wastewater treatment, Land application, Wastewater treatment facilities, Spray irrigation, Vegetation.

Leachate is currently being pumped from the Brookhaven (New York) landfill to be treated at the Southwest Sewer District's Bergen Point Treatment Plant at a rate of 120,000 gallons of leachate per week. An alternative method of leachate treatment was proposed which will employ recirculation of leachate at first on a small completed section of the landfill. Three experimental plots, each 50 by 50 ft. were devised, encompassing the broadest possible selection of plant species. Sprinkler heads applied about 6 gallons per minute of leachate pumped from a 48 inch wet well. Each plot was treated for 33 minutes, resulting in a total deposition of about 190 gallons per plot per day, an amount equivalent to the average annual rainfall of 45 inches. Odors were noted only in the immediate vicinity of the spray plots and only during the actual spraying process. By watching how the various plant species reacted to the spraying it is recommended that slopes used for this purpose be seeded with aster, quackgrass, and hydroseed mixes. Flat areas should be seeded with water tolerant plants such as smartweed and common reed. (Baker-IVI)
W84-02356

5F. Water Treatment and Quality Alteration

REDUCTION OF NITRATE CONCENTRATION IN DRINKING WATER BY A HYBRID PROCESS WITH ZERO DISCHARGE BASED ON REVERSE OSMOSIS,
G. van Opbergen, Th. Peters, R. Rautenbach, and H. Tils.
Desalination, Vol. 47, p 267-274, May, 1983. 2 Fig, 5 Ref.

Descriptors: *Nitrates, *Water treatment, *Reverse osmosis, Drinking water, Ion exchange, Electrodialysis, Thin-film evaporation, Brine disposal.

As a consequence of the heavy utilization of artificial fertilizers, the nitrate concentration of certain well waters has increased to figures above the standards set by the German Federal authorities. If such well water cannot be diluted by corresponding amounts of nitrate-free-water, the nitrate has to be removed, at least partially. In principle, reverse osmosis is capable of reducing the nitrate concentration. There will be however a brine with high nitrate content amounting to about 10% of the feed flow which cannot be discharged into a river or a deep well. This paper discusses a hybrid process based on reverse osmosis which solves the problem of the concentrate-disposal by treating this concentrate in a zero discharge system utilizing selective ion-exchange, electrodialysis and thin-film-evaporation. A pilot-plant with a capacity of 50 cu m/d permeate is under construction on the premises of a municipal waterworks. Special factors of interest are the reliability as well as the actual costs of such a process, the possibility of utilizing brine for the regeneration of the ion-exchanger and the optimal concentration factors for every step of the process. (Author's abstract)
W84-02154

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES - V; PROCESS DEVELOPMENT,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
N. J. Anderson, and A. J. Priestley.
Water Research, Vol. 17, No. 10, p 1227-1233, 1983. 4 Fig, 6 Tab, 4 Ref.

Descriptors: *Water treatment, *Coagulation, *Magnitite, Turbidity, Color, Potable water, Caustic soda.

A process design has been developed for a continuous process to clarify turbid and colored waters with alkali treated magnetite. The magnitite, when pretreated with 200 ml of 0.1 M NaOH per 10 ml of wet magnitite slurry and washed with tap water, is capable of removing turbidity and color from river water to meet potable water standards. The design avoids the use of a filtration step and, because the equipment required for the plant is both conventional and commercially available, the process appears to be technically feasible. Critical parts of the process have been investigated in small bench scale equipment, and criteria determined for the proper selection of equipment. The caustic soda requirement has been reduced to a relatively low level, and the wash water requirement reduced to about 4% of the plant throughput. While this gives the process a good chance of being economically viable, a more accurate answer to the economic question will be given by the long term operation of a larger pilot plant. (Moore-IVI)
W84-02176

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES - VI; PILOT PLANT OPERATION,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
N. J. Anderson, B. A. Bolto, N. V. Blesing, L. O. Kolarik, and A. J. Priestley.
Water Research, Vol. 17, No. 10, p 1235-1243, 1983. 6 Fig, 6 Tab, 2 Ref.

Descriptors: *Water treatment, *Coagulation, *Magnitite, Color, Turbidity, Groundwater, Iron, Hydrogen sulfide, Australia, Perth, Mirrabooka.

A novel process which utilizes fine magnetite particles for the removal of color and turbidity from water has been tested in a 60 l/min pilot plant located at the Mirrabooka Groundwater Treatment Plant in Perth, Western Australia. The feed water is a highly colored anaerobic groundwater which contains significant levels of soluble iron and H2S. The performance of the pilot plant closely matched jar test results. The process design was optimized to achieve a high quality product water on a raw feed which was difficult to treat in the conventional alum coagulation and filtration plant. The successful operation of the pilot plant for the treatment of the Mirrabooka water proved the viability of the magnitite process as an alternative water treatment technique. The Mirrabooka water is a particularly difficult one to treat. A simpler process design would be adopted for other waters which are easier to treat. (Moore-IVI)
W84-02177

REMOVAL AND INACTIVATION OF VIRUSES BY TREATMENT PROCESSES FOR POTABLE WATER AND WASTEWATER-A REVIEW,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W84-02262

EFFECTS OF SUSPENDED SOLIDS ON INACTIVATION OF POLIOVIRUS BY CHLORINE,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
M. Kaneko, and H. Igarashi.
Water Science and Technology, Vol. 15, No. 5, p 137-143, 1983. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Virus inactivation, *Chlorination, *Disinfection, *Suspended solids, *Poliovirus, Turbidity, Activated sludge, Kaolin, Water treatment, Residual chlorine.

Solids associated viruses, which were prepared by centrifugation after mixing polioviruses with sterilized kaolin or activated sludge and/or by elution with pH 8, 2% beef extract, were inactivated by chlorine. The activated sludge was found to absorb 96% of total poliovirus added, whereas 74% of the viruses added was adsorbed to the kaolin. Activated sludge which is porous in structure protects the viruses from inactivation by chlorine more effectively than kaolin does. When the concentration of the virus containing solids was 10 mg/l, initial residual chlorine of 1.0 mg/l was not enough to get more than 3 log 10 viral reduction with 30 minutes contact time. The concentration of 1.0 mg/l could affect inactivation of viruses seriously. In order to ensure the effective inactivation of viruses in water, free chlorine residuals of more than 0.4-0.5 mg/l should be maintained for a contact time of at least 30 min at a turbidity of 1-2 units and pH below 8. (Moore-IVI)
W84-02265

VIROLOGICAL STUDY OF DRINKING AND WASTEWATER DISINFECTION BY OZONATION,

Laboatoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre les Nancy (France). Faculte de Medecine.
Ph. Hartemann, J. C. Block, J. C. Joret, J. M. Foliguet, and Y. Richard.
Water Science and Technology, Vol. 15, No. 5, p 145-154, 1983. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Ozonation, *Disinfection, *Viruses, *Water treatment, *Wastewater treatment, Poliovirus, Bacteria, Drinking water, Pilot plants.

During laboratory assays of microbiological inactivation in a pilot water treatment plant (36 l/h) with drinking water artifically contaminated with poliovirus 1 and fecal indicator bacteria, ozonation shows a very strong disinfection power. In drinking water, microorganisms are very rapidly inactivated because they are not protected by organic or mineral matter. There is no significant difference in the sensitivity of these microorganisms to ozone. In the same laboratory plant during raw wastewater disinfection assays, the indigenous enteric viruses present a greater resistance to ozone than the indigenous fecal indicators. The application of ozonation for wastewater disinfection is completely different because it is possible to inactivate a large portion of the viruses and bacteria before the 'break point'. There are important difference between the use of laboratory strains and indigenous microorganisms. The findings confirm the interest in ozone disinfection of wastewater at a time of controversy over the need for, and impact of disinfection. (Moore-IVI)
W84-02266

OFF-FLAVOURS IN AQUATIC ECOSYSTEMS - AN INTRODUCTION,
Helsinki Univ. (Finland). Dept. of Limnology.
P. E. Persson.
Water Science and Technology, Vol. 15, No. 6-7, p 1-11, 1983. 2 Tab, 63 Ref.

Descriptors: *Taste, *Odors, *Ecosystems, Natural waters, Drinking water, Fish management, Organoleptic properties, Taste-producing algae, Pollutant identification.

The practical consequences of off-flavors are obvious, and include consumer dissatisfaction, high treatment costs for water works, economic losses to fisheries, and reduced esthetic value of recreational areas. In order to elucidate the sources and causes of off-flavors in natural waters, an integration of sensory, chemical and biological research is needed. Sensory characterization of off-flavors often involves taste and odor threshold measurements. In current water works practice, the odor of water samples is usually characterized by the threshold odor number (TON) test. Instead of reporting the geometrical mean of the TONs of the individual panelists, the actual percentage of panelists detecting an odor in each dilution could be determined, and the ensuing graph used to determine the dilution corresponding to 50% detection. There is a need for a more comprehensive approach, where sensory response is related to stimulus intensity over a large range of magnitudes. The use of consumer panels in sensory assessment of water quality is advocated. Sensory methods are useful screening methods. Chemical analyses should be related to the sensory characteristics of the compounds analysed. Recent research on biogenic off-flavors in natural waters have indicated that they are more complex than originally conceived. The following criteria should be used for establishing odor production by organisms: ecological evidence, the concurrence of odor and organism in the field; isolation of organism and proof of odor production in the laboratory; and chemical identification and sensory characterization of odor compounds. Compilations of scientifically proved taste and odor producing algae and microorganisms may be useful, but more research is needed on the reasons for variability of their odor production. The development of relevant abatement techniques depends on a more complete understanding of the etiology of off-flavors in natural waters. (Moore-IVI)
W84-02267

DRINKING WATER CONTAMINATION AND TASTE ASSESSMENT BY LARGE CONSUMER PANELS,
National Inst. for Water Supply, Leidschendam (Netherlands).
E. de Greef, B. C. J. Zoeteman, H. J. van Oers, E. P. Koster, and J. J. Rook.
Water Science and Technology, Vol. 15, No. 6-7, p 13-24, 1983. 5 Fig, 47 Ref.

Descriptors: *Taste, *Drinking water, *Consumer panels, Water pollution, Water quality, Organoleptic properties, Odors, Monitoring.

Sensory evaluation of drinking water is important because it is the ultimate measure of water quality for the consumer, and therefore can be considered as an acceptance criteria. In general the assessment of taste and odor of drinking water is practiced in waterworks laboratories by small panels, but it is not clear if observations by these panels reflect the opinion of the consuming population. Water taste especially is a sensitive parameter, which can be related to the presence of certain toxic chemicals. In an experimental period of 51 consecutive weeks, the sensory water quality of two distribution areas was assessed simultaneously by two consumer panels of about 100 persons each. Large panels can be kept motivated over prolonged periods of time. Comparison of the results of assessments by small laboratory panels with the consumer panel indicate that the latter is far more accurate, inexpensive and reliable and therefore renders a means for monitoring drinking water taste. Application of consumer taste panels will provide the supplier of drinking water with an expedient to establish and maintain acceptance criteria for drinking water quality with respect to taste. A combination of laboratory panels to relate taste and odor of drinking water with treatment methods and consumer panels for public acceptance evaluation is proposed. (Moore-IVI)
W84-02268

ODOUR PROBLEMS IN TWO RESERVOIRS,
Water Research Inst., Prague (Czechoslovakia).
P. Popovska.
Water Science and Technology, Vol. 15, No. 6-7, p 25-33, 1983. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Odors, *Drinking water, *Dissolved oxygen, Hubenov Reservoir, Klincava Reservoir, Czechoslovakia, Water depth, Actinomycetes, Fungi, Autotrophs, Hydrogen ion concentration.

Water from Hubenov and Klicava reservoirs (Czechoslovakia) is treated for drinking purposes, and off-flavors occur intermittently as indicated by complaints from the public. Klicava reservoir was regularly monitored for almost two years. The dissolved oxygen (DO), pH, water temperature, depth, and the relationship between numbers of autotrophs, Actinomycetes and fungi and odor intensity (OI) were measured. Using statistical methods, the relationships between odor intensity and pH, OI and DO content were shown. By multiple regression, OI in the Klicava water was found to be dependent on the concentration of DO and, to a lesser degree, on water depth. The effect of pH on OI is negligible. The Hubenov reservoir was studied for one year, with special attention to the number of Actinomycetes in particular. A negative correlation between OI and DO in the surface water was found. No significant relationship between numbers of Actinomycetes and odor intensity of the water was found. (Moore-IVI)
W84-02269

STATISTICAL EVALUATION OF THE BLIND TEST METHOD FOR WATER QUALITY CONTROL,
Service de Controle des Eaux de la Ville de Paris (France).
G. Bousquet, J. Ouvrard, S. Rigal, and R. Vilagines.
Water Science and Technology, Vol. 15, No. 6-7, p 35-46, 1983. 5 Fig, 7 Tab, 10 Ref.

Descriptors: *Taste, *Water quality control, *Taste panels, Drinking water, Statistical analysis, Sensory testing.

Each of the three taste panels, consisting of ten persons, participated in 18 water-tasting sessions which included a duplicate estimation of 4 randomly distributed dilutions. The statistical analysis of the 1,440 scores obtained showed a good correlation ($r = 0.87$) in between scores of the first water tasting and the scores of the second one. Factorial analysis showed that the panelists as a whole find a flavor in the same samples and are able to arrange the dilutions in a proper sequence. This analysis also showed that the differences in the estimation of the intensity of flavor carried out in the absence of periodical calibrations lead to a significant interval between taste threshold values given by each panel. The study of score-dilution contingency tables displayed the sensitivity of each panelist as well as the homogeneity or the heterogeneity of his panel. A change in the water origin and a simple change of the taste panel room reduced temporarily the coherence of scores. The data showed that water tasting is a reliable and reproducible technique in which the observed discrepancies among taste panels are similar to differences found in chemical analyses of palatable substances among laboratories. (Author's abstract)
W84-02270

CASE STUDIES ON OFF-FLAVOURS IN SOME NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
L. Berglind, H. Holtan, and O. M. Skulberg.
Water Science and Technology, Vol. 15, No. 6-7, p 199-209, 1983. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Taste, *Drinking water, *Algae, *Norway, Lakes, Water pollution effects, Cyanophyta, Eutrophication, Oscillatoria, Fish, Decomposition.

During the last twenty years, studies on freshwater algae in Norway have documented recent alterations in the trophic nature of several inland waters. Blooms and changes in type of algae were observed. Mass development of algae, e.g., cyanophytes, upset normal lake metabolism. Objectionable effects on taste and odor in water supplies were reported. Comprehensive studies on off-flavors were done in Lake Mjosa, River Glama, Lake Arungen, Lake Vansjo, and Lake Lyseren. Blooms of Oscillatoria species were associated with the problems in all of the lakes except Lake Lyseren, where primitive waterworks operations allow algae from the lake to enter the water supply system. The algae are decomposed by microbiological activity, forming compounds with objectionable odors. A muddy or earthy taste and odor can be imparted to water and flesh of fish by substances related to metabolism of cyanophytes and their decomposition products. In most cases when obnoxious tastes and odors occur in drinking water, algae present in the raw water are recognized either as the primary or indirect source. High algal productivity is generally to be expected before problems become severe. (Moore-IVI)
W84-02277

ODOROUS COMPOUNDS OF DIFFERENT STRAINS OF ANABAENA AND NOSTOC (CYANOBACTERIA),
Institut fur Chemische Pflanzenphysiologie der Universitat, Tubingen (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W84-02278

MUNICIPAL DRINKING WATER TREATMENT PROCEDURES FOR TASTE AND ODOUR ABATEMENT - A REVIEW,
Service de Controle des Eaux de la Ville de Paris, France.
A. J. Montiel.
Water Science and Technology, Vol. 15, No. 6-7, p 279-289, 1983. 2 Fig, 8 Tab, 33 Ref.

Descriptors: *Water treatment, *Odor, *Taste, *Paris, *France, Taste panels, Water distribution, Chlorination, Chemical treatment, Organoleptic properties, Drinking water, Water pollution sources, Microorganisms.

Taste and odor of water are sensory qualities the consumers can appreciate very easily. It is of prime importance that, during the water treatment process, taste and odors be removed and that the tap water have no abnormal taste or odor. The water works of Paris (France) has taste panels for checking the water quality by evaluation of taste and odor of water from each treatment stage every two hours. In combination with other analytical techniques, sensory methods permit the detection and localization of sources of pollution, the selection of a water treatment process and the selection of material in contact with drinking water. All the odorous compounds originating in the raw water should be removed in the treatment processes, which are clarification, oxidation and adsorption. There are two options for producing high quality treated water from odorous water: decomposition, or removal of the odorous compounds. In Paris, odorous compounds are removed by slow-sand filtration in Ivry Water Plant, chemical treatment at the Orly Water Works, and chemical and biological treatment at Saint-Maur Pilot Plant. During water treatment processes such as the oxidation stage (chlorination), tastes and odors may be produced and the use of such treatments must be carefully monitored. Tastes may be produced in the water distribution system by microbiological activity, which must be suppressed. (Moore-IVI)
W84-02282

TREATMENT METHODS FOR THE REMOVAL OF OFF-FLAVOURS FROM HEAVILY POLLUTED RIVER WATER IN THE NETHERLANDS - A REVIEW,
National Inst. for Water Supply, Leidschendam (Netherlands).
J. Hrubec, and H. A. M. de Kruijf.
Water Science and Technology, Vol. 15, No. 6-7, p 301-310, 1983. 7 Fig, 25 Ref.

Descriptors: *Water treatment, *Taste, *Odor, *Netherlands, *River Rhine, Water pollution effects, Storage reservoirs, Sand filtration, Ozonation, Activated carbon, Artificial recharge, Dunes.

In The Netherlands the raw water, obtained from the heavily polluted river Rhine, has off-flavors which must be removed by using sophisticated and expensive treatment methods to be acceptable for drinking. One method consists of storage of river water in open bankside reservoirs with residence time of a few months followed by physical-chemical treatment involving coagulation, ozonation, rapid sand filtration, activated carbon filtration and disinfection. Another method used consists of pretreatment of river water by means of coagulation and rapid sand filtration followed by underground storage in the dune areas along the North Sea coast by means of artificial recharge. The water after the recharge is treated by using aeration, dosing of powdered activated carbon, rapid sand filtration and slow sand filtration. The most effective treatment processes for improvement of taste and odor are ozonation and activated carbon filtration. (Author's abstract)
W84-02283

ODOR PROBLEMS IN LAKE BIWA,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
M. Yagi, M. Kajino, U. Matsuo, K. Ashitani, and T. Kita.
Water Science and Technology, Vol. 15, No. 6-7, p 311-321, 1983. 8 Fig, 8 Tab, 12 Ref.

Descriptors: *Odor, *Cyanophyta, *Actinomycetes, *Lake Biwa, *Japan, Water treatment, Phormidium, Anabaena, Geosmin, Methylisoborneol, Water analysis, Filtration, Activated carbon.

In 1969 a musty odor was first found in the southern basin of Lake Biwa, Japan. There are three groups of musty odor producing organisms in Lake Biwa: blue-green algae, Phormidium tenue and Anabaena macrospora; attached algae, mainly blue-green algae; and Actinomycetes in the bottom mud. In the 1970's musty odor problems commonly occurred from May to early June due to the metabolites produced by Phormidium tenue. The odor problem in the summer of 1981 was caused by an algal bloom of Anabaena macrospora. Analyses of the water taken in the lake and laboratory cultures of the blue-green algae indicate that 2-methylisoborneol is produced by P. tenue, whereas geosmin is produced by Anabaena macrospora. Purge and trap concentration followed by mass fragmentography was developed and applied as a measurement method for these two odorous compounds. The method was found to be rapid, reproducible and sensitive enough to detect the compounds at a nanogram per liter concentration level or beneath their threshold odors, requiring only a small sample (100 ml). Slow sand filtration was found to be effective in removing odor, where the odorous compounds were reduced to less than 10 ng/l in the effluents. A granular activated carbon filter, which had been in use more than one year and which no longer had the ability to adsorb trihalomethanes, was still effective in removing geosmin and 2-methylisoborneol. (Moore-IVI)
W84-02284

CLEANING AND LINING OLD WATER MAINS SAVES MILLIONS FOR MASSACHUSETTS COMMUNITY,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 8A.
W84-02352

OZONATION FOR EFFECTION THM CONTROL,
City Management Dept., Belle Glade, FL.
R. Wagner, and R. A. Elefritz.
Public Works, Vol. 114, No. 4, p 46-49, April, 1983. 2 Fig.

Descriptors: *Water treatment, *Ozonation, *Trihalomethanes, Drinking water, Ozone, Disinfection, Flocculation, Lake Okeechobee, Belle Glade, Florida.

Belle Glade, Florida is an agricultural community located on the southeast shore of Lake Okeechobee with a population of 17,000. The lake constitutes the only secure supply of fresh water in the Glades region, and the city has used it as a potable supply for many years. Treatment is necessary as the inshore waters are of a poor quality with a great deal of humic color and organic content, turbidity and biological growth. Drought, low lake levels, and periodic irrigation canal back pumping have all compounded the problem. A new process has been developed for Belle Glade involving the use of small amounts of ozone in pre- and post-treatment to modify the trihalomethane precursors in solution. The plan takes advantage of the microflocculation properties of ozone. Small amounts of ozone reacting with organic molecules into much less soluble components. The resulting materials are only semi-soluble and form a foamy particulate mass than can be physically removed from the water flow. The economics of the treatment system are briefly considered. (Baker-IVI)
W84-02353

WHEN OPEN TAPS ONLY DRIP,
Wade, Trim and Associates, Inc. Taylor, MI.
D. R. Trim.
Public Works, Vol. 114, No. 6, p 60-62, June, 1983. 2 Fig.

Descriptors: *System analysis, *Water management, Kalamazoo, Portage, Michigan, Water supply development, Pumps, Reservoirs, Hydraulic equipment, Planning.

About 300,000 customers currently draw water from 117 wells that supply five distribution zones for the city of Kalamazoo plus inhabitants of the city of Portage and five suburban townships. The distribution zones make up a total network of about 500 miles of 2 inch through 30 inch diameter mains, involving 20 pumping stations with chlorination facilities, and augmented by 16 million gallons of above ground storage capacity. During the winter about 18 million gallons per day are consumed. In the summer the use rises to 30 to 35 million gallons. A hydraulic network analysis was completed to deal with problems of low pressure in the system. The analysis called for construction of a reservoir of the Hydropillar design type. An extensive review of various types of pumps to be used in a new pumping station was made, also resulting from the network analysis. Currently the reservoir in combination with the pumping station and well fields will supply drinking water in the study zone for the next 20 to 30 years, all the while maintaining adequate pressure. (Baker-IVI)
W84-02358

CORROSION AND SCALE INHIBITORS FOR WATER DISTRIBUTION SYSTEMS,
Stearns and Wheeler, Cazenovia, NY.
W. E. McFarland.
Public Works, Vol. 117, No. 7, p 53-56, July, 1983. 1 Tab.

Descriptors: *Corrosion control, *Chemical treatment, *Water distribution, Corrosion, Scaling, Fouling, Water conveyance, Potable water, Public health, Water treatment, Corrosion control.

Corrosion and scaling are continuous problems in many water systems and may go unnoticed in day to day operations. Fire flow tests and Hazen-Williams C value determinations are useful indicators for assessing the condition of a distribution system and the need for a scale or corrosion control program. Operating costs increase as a distribution system deteriorates. Effects of corrosion and scaling on plumbing systems and hot water heaters also result in increased costs to users, although they are not reflected in the waterworks budget. With proper water treatment, many of the problems of corrosion and scaling can be reduced. A conventional method of treatment is to adjust pH, calcium, and alkalinity levels to where the water is balanced relative to calcium carbonate. An alternative method of corrosion control is the use of inorganic chemical inhibitors. In addition to applications in distribution systems, chemical inhibitors have been found useful for redeveloping water wells, and can help prevent formation of deposits on filters and other equipment in water treatment plants. Most chemical inhibitor products are readily dissolved in water and are designed for addition as a dilute solution. Even so, they should be added only after careful experimentation and with complete approval of state and local health agencies, when they are to be used in potable waters. (Baker-IVI)
W84-02361

ACTIVATED CARBON TREATMENT RESTORES ACTON WATER SUPPLY,
Acton Water District, MA.
J. E. MacLeod, and G. A. Allan.
American City and Country, p 32-35, November, 1983.

Descriptors: *Drinking water, *Activated carbon, Adsorbents, Acton, Massachusetts, Aquifer management, Groundwater pollution, Water quality, Aeration, Hydrocarbons, Chlorinated hydrocarbons.

During the past four years the closing of more than two dozen public water supplies in Massachusetts has demonstrated the susceptibility of groundwater to contamination. One of the first communities to be affected was Acton, located 22 miles west of Boston. Two wells were removed from service due to contamination with several organic chemicals, including trichloroethylene, dichloroethylene, methylene chloride and benzene. The probable cause of contamination was the waste disposal practices of a nearby chemical plant. The primary source were a landfill and several lagoons filled with liquid wastes, located about 2,500-3000 ft north of the municipal wells. The groundwater gradient across the aquifer slopes from north to south. Rather than seek new supplies, Acton decided to treat the volatile organics and proved such a step to be only possible but economical as well. Granular activated carbon and aeration were effective in removing the chlorinated hydrocarbons from the aquifer. (Baker-IVI)
W84-02372

5G. Water Quality Control

MOVEMENT OF BACTERIA AND NUTRIENTS FROM PIT LATRINES IN THE BOUNDARY WATERS CANOE AREA WILDERNESS,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
D. S. Nichols, D. Prettyman, and M. Gross.
Water, Air, and Soil Pollution, Vol. 20, No. 2, p 171-180, August 1983. 4 Tab, 33 Ref.

Descriptors: *Latrines, *Water pollution control, *Bacteria, *Nutrients, Camp sites, Boundary Waters Canoe Area, Minnesota, Water quality, Nitrogen, Phosphorus, Fecal bacteria, Peat liners.

Sanitary facilities in the Boundary Waters Canoe Area Wilderness (BWCAW) in the Superior National forest in northeastern Minnesota consist of about 2100 pit latrines located at campsites on about 400 lakes. Because of the heavy visitor use and the thin mantle of soil over bedrock in many places, there is concern that the high-quality surface waters may be polluted by microorganisms and nutrients from the pit latrines. The movement of fecal bacteria, N, and P from pit latrines in the BWCAW was studied, as well as the effectiveness of peat latrines in reducing this movement. When latrines are constructed where only a thin layer of permeable soil overlies bedrock or other impermeable material, fecal bacteria can be carried considerable distances by subsurface flow. Lining latrine pits with acid peat appears to reduce bacteria transport. Most soils strongly adsorb P and prevent its movement. No movement of P from latrine pits was seen except at one site with very sandy soil. In such soil a peat liner appears to be of some value, if a peat with a high P adsorption capacity is used. A peat liner should be viewed as an additional protection against P and bacteria movement rather than as a substitute for proper soil conditions. Latrines should not be built in thin, rocky soils. Nitrogen appears to move readily from toilet pits, regardless of soil type or presence of peat liners. But, because of dilution, N is not likely to have a discernible impact on water quality. (Moore-IVI)
W84-02136

EVALUATION OF SEDIMENT AND PHOSPHORUS MANAGEMENT PRACTICES IN THE WHITE CLAY LAKE WATERSHED,
Wisconsin Dept. of Natural Resources, Madison.
L. A. Persson, J. O. Peterson, and F. W. Madison.
Water Resources Bulletin, Vol. 19, No. 5, p 753-762, October, 1983. 2 Fig, 9 Tab, 21 Ref. EPA grant R804823.

Descriptors: *Water quality management, *Sediments, *Phosphorus, Nonpoint pollution sources, White Clay Lake, Wisconsin, Mathematical models, Animal wastes, Land use, Nutrients, Water pollution control, Soil erosion, Snowmelt, Thaw, [illegible]wastes, Phosphorus, Lakes, Wetlands, Agri[illegible]al runoff.

To evaluate the effects of management practices for protection of water quality in White Clay Lake (Wisconsin), surface and lake waters were monitored for a six-year period before and during structural and management changes for nonpoint pollution source control. The incremental nature of implementing controls combined with the annual variations in sediment and nutrient transport confounded obvious changes in water quality. So, several models were linked together to define loadings from specific land uses and to assess the effects of management changes and animal waste control measures designed to reduce sediment and phosphorus losses. The importance of including the thaw and snowmelt factor in the determination of erosion index for the Universal Soil Loss Equation was demonstrated. Model predictions of average annual phosphorus loading showed a 54% reduction following the installation of manure storage facilities and barnyard runoff controls, and a 22% reduction through changes in cropland management. The model also predicted a 29% reduction in sediment loading. The value of a peripheral wetland for retention of sediment and phosphorus was quantified. Changes in lake water quality attributable to the watershed work were not observed, but maintenance of existing good water quality as a result of this project is anticipated. (Author's abstract)
W84-02163

EFFECTS OF HYDRILLA AND GRASS CARP ON WATER QUALITY IN A FLORIDA LAKE,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr., M. J. Maceina, and J. V. Shireman.
Water Resources Bulletin, Vol. 19, No. 5, p 773-778, October, 1983. 2 Fig, 1 Tab, 38 Ref.

Descriptors: *Hydrilla, *Aquatic plants, *Aquatic weed control, *Grass carp, Environmental effects, Chlorophyll a, Transparency, Alkalinity, Calcium, Magnesium, Potassium, Phosphorus, Lake Baldwin, Florida.

Changes in water chemistry, water clarity, and planktonic chlorophyll a were measured as hydrilla (Hydrilla verticillata) abundance increased and then decreased in Lake Baldwin, Florida. Grass carp (Ctenopharyngodon idella) were used to eliminate submersed macrophytes. No major trends in lake pH, conductivity, or total nitrogen concentrations occurred in association with changes in hydrilla levels. Increased Secchi disc transparency and reductions in total alkalinity, calcium, magnesium, potassium, total phosphorus, and chlorophyll a concentrations occurred as hydrilla abundance increased. Large increases in the chemical parameters and a reduction in Secchi disc transparency occurred as hydrilla decreased and was eliminated from the lake by grass carp. The effects of hydrilla on lake water chemistry are related to the percentage of the lake's volume infested with hydrilla and macrophyte standing crop. (Author's abstract)
W84-02166

CONTROLLING GROUND WATER DEGRADATION IN THE TULARE LAKE BASIN,
California Univ., Davis. Dept. of Civil Engineering.
O. Helweg, and S. Arora.
Water Resources Bulletin, Vol. 19, No. 5, p 837-844, October, 1983. 5 Fig, 5 Tab, 8 Ref. OWRT project A-529-CAL, WRC project UCAL-WRC-W529.

Descriptors: *Groundwater pollution, *Salinity, *Water quality control, Tulare Lake Basin, California, ASTRAN, Irrigation effects, Water pollution control, Fertilizers, Soil amendments, Computer models.

The feasibility of extending the Accelerated Salt Transport (ASTRAN) method of ground water quality control to a complex, closed basin which is experiencing ground water quality degradation from irrigated agriculture (e.g. the Tulare Lake Basin in the southern portion of the California Central Valley) was examined. A linear programming model was constructed and parametric analysis conducted which produced results with a 'general appraisal' (or 'level B') degree of accuracy. The groundwater salinity will continue to increase unless substantial measures are taken to control the trend. The ASTRAN method along with the other controls such as limiting new land development and increasing the application efficiency of fertilizers and soil amendments can control groundwater salinity (degradation). Applying the ASTRAN method will not have as great an impact as preventing future leaching of salts from native subsoils and limiting salinity from soil amendments. There is no apparent feasible way salinity can be controlled as formulated in this study without additional imported water and additional drainage out of the basin. (Moore-IVI)
W84-02174

EARLY WARNING SYSTEM FOR DETECTING EARTHY-MUSTY ODORS IN RESERVOIRS,
Metropolitan Water District of Southern California, La Verne. Water Quality Branch.
M. J. McGuire, S. W. Krasner, C. J. Hwang, and G. Izaguirre.
Water Science and Technology, Vol. 15, No. 6-7, p 267-277, 1983. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Odors, *Monitoring, *Reservoirs, *Oscillatoria, *Lake Mathews, California, Methylisoborneol, Closed-loop stripping analysis, Cyanophyta, Sampling, Algicides, Diffusion, Thermoclines, Water quality control.

A taste and odor problem in 1980 in Lake Mathews, a reservoir in Southern California, was detected after it was already well under way. An early warning system was devised in 1981 to detect an earthy-musty odor problem in its formative stage. Oscillatoria curviceps was confirmed as the organism which caused nuisance levels of 2-methylisoborneol (MIB) in Lake Mathews. The early warning system was specifically developed to monitor attached blue-green algal growths in a reservoir using closed-loop stripping analysis (CLSA) of samples collected near the growths. The CLSA technique proved to be a reliable and rapid methos of determining ng/l concentrations of an earthy-musty organic compound. Sampling above the attached blue-green algal growths and analysis by CLSA gave one month's warning of an odor problem in Lake Mathews. Fixed monitoring stations and a similar sampling and analysis scheme can be used by other utilities to solve similar problems. MIB appeared to diffuse through a strong thermocline and became thoroughly mixed in the water column. Application of Cutrine-Plus as an algicide for bottom-growing organisms had a limited effect in this instance. Death of O. curviceps appeared to be from natural causes. (Moore-IVI)
W84-02281

MEASURES TO PREVENT WATER POLLUTION BY CHEMICAL FERTILIZERS AND SOIL EROSION PRODUCTS,
For primary bibliographic entry see Field 5B.
W84-02324

PROTECTION OF SURFACE WATERS IN THE USSR,
V. S. Kaminskii.
Water Resources, Vol. 9, No. 6, p 635-649, November-December, 1982. 66 Ref. Translated from Vodnye Resursy, No. 6, p 93-109, November-December, 1982.

Descriptors: *Surface waters, *Water quality control, *USSR, Environmental protection, Water pollution control, Political aspects, Industrial wastes, Legislation, Acid rain, Water analysis.

Control of environmental pollution to protect the quality of available water is becoming an increasingly important problem and concern in the world. The manner in which the problem is addressed in socialistic countries is compared briefly with the approach in capitalistic societies. The impact of Lenin's theory and practice of environmental protection is noted. Soviet legislation in this area is mentioned. Since 1972 more than 400 water protection installations with a total capacity of about 1.5 cu km/year and also biological wastewater treatment plants of about the same capacity have been put into operation at more than 300 enterprises of the basin in Kalinin, Gorky, Kuibyshev, Ul'yanovsk, Volgograd, and other cities. In the main harmful substances still enter the waterways from the fuel and power industry, metallurgical, chemical, petrochemical, pulp and paper, light and food industries and also through agricultural production. Evaluation of water quality from hydrobiological positions has been investigated with a multitude of biotests being proposed in the world literature for that purpose. A comparative evaluation of different systems of hydrobiological analysis of polluted waters in rivers was made. The Woodiwiss method proved the most suited for biological analysis. Problems being experienced through the precipitation of acid rains are noted. In the 11th Five Year Plan there will be a united collaboration of fraternal union republics which will be a decisive step forward in improving the quality of one of the most important components of the biosphere, fresh water. (Baker-IVI)
W84-02338

IS YOUR COMMUNITY'S GROUNDWATER SAFE TO DRINK,
Malcolm Pirnie, Inc., Paramus, NJ.
A. F. Hess, J. E. Dyksen, and H. J. Dunn.
Public Works, Vol. 114, No. 10, p 72-76, October, 1983. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Groundwater protection, *Monitoring, Chlorinated hydrocarbons, Solvents, Organic compounds, Inorganic compounds, Fluoride, Nitrates, Barium, Selenium, Arsenic.

A number of groundwater supplies around the United States have experienced water quality degradation due to high inorganic and/or organic chemical levels. Finding cost-effective means of controlling these chemicals represents a challenge for water suppliers and water utility engineers. However, proper planning and evaluation of alternatives will enable water utilities to provide an effective method for ridding groundwater supplies of many inorganic and/or organic problems. The five most abundant primary inorganic contaminants are fluoride, nitrate, selenium, barium, and arsenic. Groundwater supplies with organic contaminants typically contain several solvents. Of all the groundwater samples collected and analyzed, trichloroethylene has been detected more frequently and in the highest concentrations. Tetrachloroethylene ranks second in frequently of occurrence. Within a specific well, at least one or two organic compounds at relatively high concentrations of 100-500 micrograms/liter will likely predominate with several other identifiable compounds present at lower concentrations or less than 50 micrograms/liter. A given wellfield may include one well with a preponderance of one or two compounds at high concentrations, whereas in another well in the same area several different compounds may dominate. (Baker-IVI)
W84-02362

INTRODUCTION TO THE NIAGARA RIVER/LAKE ONTARIO POLLUTION PROBLEM,
Canada Center for Inland Waters, Burlington, Ontario. National Water Research Inst.
R. J. Allan, A. Mudroch, and A. Sudar.
Journal of Great Lakes Research, Vol. 9, No. 2, p 111-117, 1983. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution control, *Governmental interrelations, *Lake Ontario, *Niagara River, Great Lakes, Water pollution sources, Toxic substances, Hazardous wastes, Waste disposal, Monitoring, Canada, United States.

A cooperative effort has been begun by Canadian and United States research scientists to provide basic information which may be needed to enforce controls of loadings of toxic chemicals to the Lake Ontario and Niagara River system. The objectives of the cooperative effort will be to define the past and present status of contamination and develop a predictive capacity in relation to control alternatives; to provide information that will lead an assessment of the need to reconstruct old or redesign new waste dumps; provide information to support bilateral negotiations aimed at control of point and diffuse sources of hazardous chemicals; provide information that will assist in the design of scientifically sound monitoring strategies to assess reductions in point and non-point sources of toxic chemicals to Lake Ontario, and provide, if feasible, input to whole lake or basin management strategies which may accelerate recovery of Lake Ontario. (Baker-IVI)
W84-02402

SPONTANEOUS POTENTIAL CORRECTIONS FOR GROUNDWATER SALINITY CALCULATIONS - CARTER COUNTY, OKLAHOMA, U.S.A.,
Bradley Univ., Pretoria, IL. Dept. of Geological Sciences.
C. L. McConnell.
Journal of Hydrology, Vol. 65, No. 4, p 363-372, September, 1983. 7 Fig, 14 Ref.

Descriptors: *Groundwater, *Salinity, Water quality control, *Carter County, *Oklahoma, Water pollution prevention, Oil wells, Oil industry, Dissolved solids,.

The thickness and distribution of groundwater with a total dissolved solids (TDS) of less than 1000 mg/l were computed using the spontaneous potential log for Carter County, Oklahoma. Empirical correction factors had to be developed and applied to compute accurate salinities from the spontaneous potential in high-resistivity zones. Present equivalent water resistivity vs water resistivity curves were developed for the formations from chemical analyses and digitized. Water resistivity vs TDS curves were also developed and digitized. The existing empirical thin-bed corrections were curve-fit with equations and applied to each zone. Except in beds less than 3.65 m thick they had little effect. A data base was compiled using 704 oil-well electric logs including data from all zones from the base of the regolith to a depth where the TDS was greater than 10,000 mg/l TDS. The TDS was computed for each zone. Two maps were prepared from the results; an isopach of the formations with TDS of less than 1000 mg/l and a depth to the base of the water with TDS of 1000 mg/l. The borehole environmental correction factor was greater for salty muds than predicted by earlier electric analog models. This correction was largely independent of bed thickness between 3.65 and 7.60 m which is the normal thickness of these beds. Testing the correction factors on zones of known water chemistry zones have TDS of about 750 mg/l lowered the average computed TDS from 1030 to 823 mg/l. (Baker-IVI)
W84-02456

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER SUPPLY AND URBAN GROWTH PLANNING: A PARTNERSHIP,
Palliser Regional Planning Commission, Hanna (Alberta).
W. J. Ashton, and M. B. Bayer.
Water Resources Bulletin, Vol. 19, No. 5, p 779-783, October, 1983. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Water supply, *Land use, *Planning, *Urban areas, Water resources development, Water demand, Water conservation, Regional planning, Regional development, Calgary, Alberta.

As urban expansion outstrips water supplies, the usual solution is to build pipelines to bring in water from sources farther afield. Such water supplies may act as either a leader of urban development or as a follower. In either case, this engineering approach to the provision of water has fostered less than optimal utilization of regional water and land resources for urban growth. More efficient utilization of these resources is achieved when water supply development and urban growth planning are conjoint activities. Water supply planners and land use planners, working together, are able to generate and evaluate the full range of urban development options, including water demand management through conservation. Preferred regional growth plans are achieved using the best mix of water supply and urban growth. The result is a reduced rate of water supply development and a reduction of urban expansion on prime lands. This partnership approach is demonstrated for the Calgary Region (Alberta) under two levels of water conservation. (Author's abstract)
W84-02167

PERSPECTIVES ON THE FUTURE OF THE INDIAN RIVER SYSTEM,
Florida Sea Grant Marine Advisory Program, Melbourne.
L. T. Johnson.
Florida Scientist, Vol. 46, No. 3/4, p 132-134, 1983. 4 Ref.

Descriptors: *Water resources development, *Indian River system, *Florida, Planning, Information, Resources development.

The Indian River system extends from Ponce de Leon Inlet to St. Lucie Inlet (Florida) and drains an increasingly populated watershed. The Future of the Indian River system (FIRST) Steering Committee was formed in April 1981 by representatives of 4 Florida scientific institutions to promote the wise utilization and optimum productivity of the Indian River system. This system is a significant economic, scientific, educational, recreational, and aesthetic resource. The FIRST Steering Committee will form a permanent organization to act as a clearing house for information on the Indian River system and to sponsor annual symposia. Symposia will alternate between research needs, and potential solutions will be discussed and referred to decision makers. The Indian River System Information Symposium is the first of the research meetings. (Author's abstract)
W84-02248

HIERARCHICAL MODEL OF OPTIMIZATION OF THE STRUCTURE OF WATER RESOURCES SYSTEMS,
D. Velev, I. Mesechkova, and V. Mikhailov.
Water Resources, Vol. 10, No, 1, p 1-7, January-February, 1983. 1 Fig, 6 Ref. Translated from Vodnye Resursy, No. 1, p 3-10, January-February, 1983.

Descriptors: *Model studies, *Decision making, *Water resources development, Water supply, Hierarchical models, Optimization, Planning.

Attempts are made to optimize the decisions as to when, where and what type of water resource systems (WRS's) should be formed and developed to meet the ever increasing water requirements most economically. The specific character of the problem of developing WRS's governs the direct relation between investigations in this area and long range national economic planning. WRS's belong to the class of large dynamic systems whose main charactertistics are a hierarchical character and complex structural interrelations between elements. Optimization of individual subsystems is carried out at the first level of the hierarchy with given values of certain variables determined by the coordinator of the second level. In the next stage the first level reports the values of the objective functions of the subsystems to the coordinator of the second level, who assigns new values of the coordinating variables. This process continues until the global optimum of the systems is determined. For WRS's with limited water resources a correctly selected strategy of development for a long period can lead to more favorable results and is the decisive condition for effective use of water resources. (Baker-IVI)
W84-02340

ANALYSIS OF THE EFFECTIVENESS OF USING INFLOW AND WATER CONSUMPTION FORECASTS WHEN CONTROLLING WATER RESOURCES SYSTEMS,
P. Kvasnikov.
Water Resources, Vol. 10, No. 1, p 15-19, January-February, 1983. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 1, p 19-24, January-February, 1983.

Descriptors: *Planning, *Water resources development, Water supply, Bulgaria, Model studies, Water demand, River forecasting, Consumptive use, Irrigation, Floods, Low flow.

The steady increase of water consumption in Bulgaria is necessitating the more rational and effective use of limited water resources. One way of solving the problems is to improve the existing methods of controlling water resources systems by using forecasts of the inflow and water consumption which is especially essential for the irrigation of farmlands. At present consumptive use is forecast on the basis of a forecast of the available heat supply and cumulative soil moisture deficits during the entire growing season. The optimal distribution of water between crops is carried out under conditions of a shortage of water resources, which requires forecasting the loss functions for all crops. The content and form of forecasts of inflow into a reservoir are quite diverse and depend both on the purpose of the forecasts and on the possibilities of

obtaining them. Considerable research has been carried out in Bulgaria in the area of long range forecasting of river runoff for issuing probability forecasts for the spring flood and summer low streamflow periods and attempts have been made to compile basic long range and very long range forecasts of inflow to reservoirs. The use of simulation modeling to solve these problems is considered. (Baker-IVI)
W84-02342

OPTIMIZATION OF THE OPERATING AND REORGANIZATION OF EXISTING COMPLEX WATER RESOURCES SYSTEMS,
S. Yancheva.
Water Resources, Vol. 10, No. 1, p 20-28, January-February, 1983. 6 Fig, 1 Tab, 28 Ref. Translated from Vodnye Resursy, No. 1, p 25-34, January-February, 1983.

Descriptors: *Water resources development, *Planning, Model studies, Mathematical models, Dam construction, Reservoirs, Decision making.

The problem of coordinating the varying resources of water and the demand for water as it concerns providing the economy with water and conserving water resources is addressed. The main means of achieving such control is the redistribution of water resources in time by streamflow regulation by reservoirs, and in space by interbasin and interregion water transfers. The problem of designing water systems in general is presently regarded as a two stage problem of stochastic programming. In the first stage of solution the main parameters of the water system are established and in the second stage the control regime providing fulfillment of the selected parameters is determined. The use of results of optimizing long and short range operating regimes of a water system for determining its parameters is a possible unified methodological basis for solving the indicated problems. The probabilistic component of water consumption is determined by the random factors influencing it. Mathematical models are presented for optimization of the operation and reorganization of developing water systems, for verification of the regulating possibilities of existing complex water resources systems, and for the buildup of the reservoir without water transfer from other sources. (Baker-IVI)
W84-02343

PUTTING MICROCOMPUTERS TO PRACTICAL USE ON WATER AND WASTEWATER PROJECTS,
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
P. Giguere.
Public Works, Vol. 114, No. 5, p 50-52, 90, May, 1983. 2 Fig.

Descriptors: *Computers, *Management, *Wastewater treatment, Water management, Energy, Wastewater, Groundwater pollution, Water supply, Microcomputers, Systems analysis.

The advent of the powerful, low cost microcomputers and easy to use application programs has made possible the use of computers to assist in computations, data management, report writing, design, budgeting, and project management to a far greater extent than was heretofore possible. Recent applications in the wastewater and water resources fields include groundwater and surface water modeling, sewer system analysis and design, water distribution system analysis, data management, construction quantity take-offs, and cost estimating. Somewhat detailed examples of the usefulness of small computers are offered in the areas of sewer master planning and treatment plant management. Other recent applications of computer systems include water allocation and groundwater pollution. (Baker-IVI)
W84-02355

6B. Evaluation Process

SOCIAL IMPACT OF RESERVOIR CONSTRUCTION IN THE URBAN FRINGE: A TEN-YEAR COMPARISON,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
T. L. Napier, E. G. Bryant, and S. McClaskie.
Water Resources Bulletin, Vol. 19, No. 5, p 811-819, October, 1983. 3 Fig, 47 Ref.

Descriptors: *Social impact, *Reservoirs, *Attitudes, Public opinion, Social adjustment, Social change, Water resources development.

A longitudinal research design was used to compare attitudes toward selected components of a reservoir affected community in the urban fringe of a major metropolitan area in central Ohio. The study data were collected at three intervals over a ten-year period (1970, 1974, 1980). Evaluation of resident opinions in the affected community revealed significant attitude differences over time for four of the five variables measured. The study group desired more social stability but had accommodated the changes experienced to date. Responses to the attitude scales showed that the people in the study group were well integrated and were closely identified with each other at all three test periods. Given the magnitude of changes introduced in the community, the positive findings strongly suggest that the social fabric of human groups is very resilient and is quite adaptive to extensive changes even when the social milieu is subjected to considerable stress. These data also suggest that inmigrants were being quickly assimilated into the restructured social milieu. Attitudes toward the lake project were significantly more positive over time, and in 1980 the collective community group held a basically neutral attitude about the lake. Both long-term and short-term residents are becoming more positive over time concerning the actions of the development agency. (Moore-IVI)
W84-02171

OPPORTUNITY COST OF TRAVEL TIME IN RECREATION DEMAND MODELS,
Vanderbilt Univ., Nashville, TN. Dept. of Economics.
V. K. Smith, W. H. Desvousges, and M. P. McGivney.
Land Economics, Vol. 59, No. 3, p 259-278, August, 1983. 6 Tab, 33 Ref.

Descriptors: *Recreation demand, *Cost analysis, *Model studies, Recreation, Water demand, Water use, Dams, Lakes, Reservoirs, Rivers, Travel time.

Current proposals for valuing travel time in the specification of recreation demand models is evaluated. Based on a household production framework, the analysis examines the implications of the treatment of travel and onsite times in recreation models. The empirical results are based on demand functions estimated for 43 water based recreation sites with the Federal Estate component of the 1977 National Recreation Survey. A redirection in the research on modeling the demand for outdoor recreation sites is warranted. The theoretical analysis implies that the definition of the nature of and the interrelationship between an individual's time constraints plays a central role in the determination of the individual's corresponding opportunity cost of travel time. The empirical findings of forty-three site demand models for water recreation suggest that the treatment of the costs of on-site time is important to the empirical analysis of the oppportunity cost of travel time; that the difference between the full-cost and Cesario proposals for measuring these opportunity costs are not sufficient to prefer the latter to the former; and that the estimation of the multiple relating these opportunity costs to the wage is not a trivial task. (Baker-IVI)
W84-02233

DEMAND CURVE FOR RECREATIONAL FISHING WITH AN APPLICATION TO STOCK ENHANCEMENT ACTIVITIES,
Delaware Univ., Newark. Coll. of Marine Studies.
L. G. Anderson.
Land Economics, Vol. 59, No. 3, p 279-286, August, 1983. 3 Fig, 14 Ref. NSF Grant 75-11205.

Descriptors: *Recreation demand, *Model studies, *Sport fishing, Recreation, Fishing, Fish stocking, Fish ladders.

Models of recreational fishing have been developed by earlier studies and have derived conditions for optimal management policy both with and without joint commercial harvest. While these earlier models are correct, their structures do not explicitly consider the stock externality in terms of the demand curve for recreational fishing. In many recreational fisheries, it is possible to undertake activities, such as fish stocking and construction of fish ladders, which can affect the exploited stock such that the quality of recreational fishing is improved. The effect each participant has on others, in terms of quality and quantity, is central to an intuitive understanding of recreational fisheries management and it can be clearly demonstrated in the demand curve model presented in this study. The model is applicable to a number of relevant problems, including joint recreation-commercial exploitation, but it is applied in this work to the optimization of enhancement. (Baker-IVI)
W84-02234

OPTIMAL CONTROL OF COMPLEX WATER RESOURCES SYSTEMS IN BULGARIA,
N. Kolev, S. Yancheva, and K. Nikolova.
Water Resources, Vol. 10, No. 1, p 8-14, January-February, 1983. 6 Fig, 4 Ref. Translated from Vodnye Resursy, No. 1, p 11-18, January-February, 1983.

Descriptors: *Planning, *Water resources development, *Bulgaria, Mathematical models, Model studies, Reservoir operation, Water demand.

Optimization of the regimes of use and distributions of water resources of a real complex water resources system with a seasonal reservoir is discussed. A four stage mathematical model is proposed for optimal control of the complex water resources system under water shortage conditions. In the first stage the regulating possibilities of the existing reservoir are checked on the basis of optimization calculations, and variants for its reorganization are outlined if necessary. The second stage consists in solving the distribution problem, in which, by optimal distribution of the water shortage between participants of the complex water resources system on the basis of the technicoeconomic characteristic of individual water consumers and users, their requirements are coordinated with the available water resources. In the third stage the distribution of optimal water deliveries between water consumers and users of the system is carried out on the basis of the results obtained on solving the regime problem. (Baker-IVI)
W84-02341

SEWER SYSTEM REHABILITATION BY THE NUMBERS,
Donohue and Associates, Inc., Waukesha, WI.
J. S. Kipp.
Public Works, Vol. 114, No. 5, p 75-76, May, 1983.

Descriptors: *Sewer systems, *Rehabilitation, Design criteria, Planning, Decision making, Engineering.

A typical scenario of the sewer rehabilitation process is presented so that projects can proceed smoothly and produce the repairs needed to provide efficient, effective, and economical sewer service. The overall rehabilitation process is a three-step process. First, the Sewer System Evaluation Survey is made and subsequent rehabilitation recommendations made based on the survey results. Secondly, the engineering design of the repairs themselves is completed. Thirdly, detailed construction inspection is carried out during the actual repair work. This three step process has allowed for cost effective identification, design, and construction of those repairs needed to restore the sewer system under question to a proper level of service. (Baker-IVI)
W84-02357

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER RATES: DO THEY REFLECT COSTS,
Michigan Dept. of Public Health, Escanaba. Environmental and Occupational Health Sciences Administration.
C. L. Courchaine.
Public Works, Vol. 114, No. 6, p 86-88, June, 1983. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Water rates, Economic aspects, Costs, Michigan, Upper Peninsula, Water treatment, Construction.

A water rate study was conducted in 1982 by means of a questionnaire initially sent to 90 water suppliers in the Upper Peninsula of Michigan. An excellent 95.5% response rate was achieved. Water rates appeared to be more affected by the source and type of treatment than by size. The least expensive public water supplies are those where groundwater is available and do not require treatment for either public health or aesthetic reasons, regardless of the size of the community. Purchased water was among the most costly means of obtaining a drinking water source in the study area. This is affected greatly by the interpretation of Michigan's former law that permitted water suppliers to charge outside customers 3200% of its own customer rates. Twenty-three communities have a water rate less than the $6 per month for 5000 gallons, and they have a median water rate of $4. These communities have had an increase in water rates of only 16.5% since 1977. In contrast, the 19 communities with a water rate greater than $10 per month for 5000 gallons have a median water rate of $12.50, and these communities have had an increase in water rates of 84% in the last five years. The predominant difference in these two groups of water supplies is that the latter have had a high percentage of construction projects that affect water rates. New concepts in rate making should be considered to assure that water rates reflect the real cost of providing service on an equitable basis. (Baker-IVI)
W84-02360

SEWAGE GRANT FUNDING IS KEY IN CLEAN WATER ACT CHANGES,
C. H. Dombrowksi.
American City and Country, p 27-28, November, 1983.

Descriptors: *Grants, *Sewer systems, Economic aspects, Clean Water Act, Federal jurisdiction, Pretreatment, Wastewater treatment.

Funding for federal sewage grants is becoming an important issue for local government officials. Amendments to the 1981 Clean Water Act (CWA) have allowed Congress to lower the percentage of sewage costs that the federal government will finance. About 5000 communities will not receive federal grants and will have to develop plans for achieving secondary treatment on their own. The most controversial issue to the local government is pretreatment. The existing program is criticized as being too cumbersome and complicated. Also being debated in this round of the CWA amendments is a new program for control of nonpoint source pollution. Problems with compliance with secondary treatment have also been raised. (Baker-IVI)
W84-02371

6D. Water Demand

CONTROL OF THE LEVEL OF LAKE ISSYK-KUL,
For primary bibliographic entry see Field 4A.
W84-02319

WATER RESOURCES, CURRENT CHARACTERISTICS, AND PROSPECTS OF WATER CONSUMPTION IN THE USA,
L. I. El'piner, and V. S. Vasil'ev.
Water Resources, Vol. 10, No. 1, p 114-121, January-February, 1983. 4 Tab, 10 Ref. Translated from Vodnye Resursy, No. 1, p 163-172, January-February, 1983.

Descriptors: *Water resources development, *Water consumption, Reviews, United States, Conservation, Industrial water, Water reuse, Consumptive use.

The rational use of water resources in the United States is reviewed. Data are provided on the characteristics of US reservoirs; on freshwater consumption in the period 1940-1975 and its forecast for 1985 and 2000; the structure of consumption of subsurface freshwaters by various sectors of the US economy such as agriculture, municipal services, industry and thermal power; the consumption of water resources by various manufacturing industries in 1975 such as chemical, iron and steel, pulp and paper, petroleum, food, transportation equipment, textiles, and other branches of the manufacturing industries. Summing up the results of analyzing the data on the use of water resources in the US it is noted that the decrease of the total volume of water consumption achieved in the mid-1970's is more correctly regarded as stabilization of its level, which is also important. The predicted estimates of the further development of this process indicate the possibility of a temporary decrease of the level of water consumption due to the introduction, mainly in the manufacturing industry, of recycled water supply systems. However, the increase of nonreturnable water consumption accompanying these methods at the level of the year 2000 will subsequently require the replacement of recycled water supply by the introduction of zero-water technological processes. Otherwise the trend toward an increase in water consumption will again intensify and cause acute situation in the United States due to the shortage of water resources. (Baker-IVI)
W84-02348

6E. Water Law and Institutions

PROTECTION OF SURFACE WATERS IN THE USSR,
For primary bibliographic entry see Field 5G.
W84-02338

6G. Ecologic Impact Of Water Development

ICE AND THERMAL CONDITIONS OF THE POOLS AT THE UST'-ILIM HYDROELECTRIC STATION,
Ya. L. Gotlib, M. V. Gorina, and A. I. Khydyakova.
Hydrotechnical Construction, Vol. 17, No. 2, p 85-89, February, 1983. 2 Fig, 5 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, o. 2, p 29-31, February, 1983.

Descriptors: *Hydroelectric plants, *Environmental effects, *Dams effects, *Reservoirs, *Ice cover, *Temperature effects, Wind, Water temperature, Ust'-Ilim Hydroelectric Station.

The ice and thermal regimes of a river change substantially with the construction of hydrostations due to a change in the discharges and temperature of the water in the lower pool. Observations of such changes were made at the Ust'-Ilim hydrostation and the effects on the region of construction of the fourth reach of the Angara cascade of hydrostations, the Boguchany, being constructed 386 km downstream of the Ust'-Ilim. Analysis of freeze-up data from the reservoir suggests that for equal or close air temperatures in the case of a greater wind speed or for equal or close wind speeds in the case of a higher air temperature, freeze-up occurs later and at a lower water temperature. In any case the longer the reservoir is subjected to the effect of wind in the prefreeze-up period, the lower will be the water temperature when freeze-up occurs. The maximum thickness of the ice cover on the reservoir is in March-April and is 0.90-1.10m. The maximum value of snow cover on the ice of 0.4-0.5m. Melting of the snow occurs by the end of April, in connection with which the surface water layers under the ice are heated more intensely and the thickness of the ice decreases. Break up occurs from the middle to the end of May. With increasing distance from the dam the water cools in the fall-winter period under the effect of meteorological conditions. Data do not suggest that there should be any substantial ice dams nor considerable rises of the level in the lower pool of the Ust'-Ilim hydrostation due to the presence of the hydrostation itself. (Baker-IVI)
W83-02297

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF DETENTION BASINS,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W84-02158

EVALUATION OF POTENTIAL WATER QUALITY PROBLEMS ASSOCIATED WITH HIGHWAY EXCAVATION AND FILL,
Texas Tech Univ., Lubbock. Water Resources Center.
G. F. Lee, and R. A. Jones.
Transporation Research Record, No. 892, p 2-8, 1983. 14 Ref.

Descriptors: *Environmental effects, *Highways, *Construction, Water quality control, Standards, Fill materials, Leachates, Testing procedures.

The excavation and disposal of materials and the use of fill materials in highway construction are potential threats to water quality. To provide guidance for the detection of potential problems from this source, the Environmental Protection Agency (EPA) published its Guidelines for Specification of Disposal Sites for Dredged and Fill Material in the Federal Register (December 24, 1980). The approaches that have been recommended for use in evaluating fill material for for environmental impact and also the approaches that should be followed for making such evaluations are discussed. Outlined is a water quality hazard assessment approach for evaluating the potential significance of contaminants associated with fill material derived from highway excavation and filling, which will promote technically valid, cost-effective, yet environmentally protective evaluation and control of excavation and fill materials associated with highway construction. (Baker-IVI)
W84-02216

QUALITY OF SEEPAGE AND LEACHATE FROM MINE AND MILL WASTES AND CONTROL OF ITS EFFECTS,
For primary bibliographic entry see Field 5B.
W84-02217

COMPARISON OF PREDICTION METHODS FOR SOIL EROSION FROM HIGHWAY CONSTRUCTION SITES,
A. C. Miller, W. J. Veon, and R. A. Chadderton.
Transportation Research Record, No. 896, p 33-39, 1983. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Highway construction, *Soil erosion, Erosion control, Mathematical studies, Design criteria, Environmental effects, Pennsylvania.

Six existing equations used by engineers to predict soil loss from highway construction sites were compared with a seventh method developed with data gathered from three highway construction sites in Pennsylvania. The accuracy of all the equations is illustrated in tabular form through the use of the average error prediction. The smallest average error is 119% and the largest is more than 600%. The significance of these errors depends on how the result is intended to be used. So long as the user is aware of the possible errors and the limits of the methods, the answers provided will be useful. A newly developed rational method provid-

ed to be the most error free. This rational model was composed of a combination of factors that represented the effects of various physical properties and hydrologic phenomena with regard to the soil erosion process and that together seemed to explain the process most reasonably. Each of the other six methods was deficient in one or more of the parameters considered to be significant. (Baker-IVI)
W84-02224

EFFECTS OF DREDGED HIGHWAY CONSTRUCTION ON WATER QUALITY IN A LOUISIANA WETLAND,
G. H. Cramer, II, and W. C. Hopkins, Jr.
Transportation Research Record, No. 896, p 47-51, 1983. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Highway effects, *Water quality control, Turbidity, Color, *Wetlands, Water quality, Environmental effects, Louisiana.

A research effort to determine, by physical and chemical means, the effect of current bridged highway construction techniques on water quality in a wetland is summarized. Selected water-quality parameters were monitored before, during, and after construction activities. Turbidity and color increased during construction and gradually returned to the preconstruction ambient in areas where construction was completed. Other parameters also followed this trend, but these changes were not as directly related to the construction activities as were turbidity and color. Elevated highway construction with environmental controls had minimal effects on the quality of the surrounding water. Local isolated activities other than highway construction produced more severe and longer-lasting effects on water quality. The information obtained may be useful in predicting the degree and duration of impacts of future construction projects on wetland environments. (Baker-IVI)
W84-02226

FIELD INSTRUMENTATION FOR MONITORING WATER-QUALITY EFFECTS OF STORMWATER RUNOFF FROM HIGHWAYS,
T. V. Dupuis, and B. N. Lord.
Transporation Research Record No. 896, p 55-60, 1983. 8 Fig, 7 Ref.

Descriptors: *Highway effects, *Storm runoff, *Monitoring, Water quality, Storm water, Hydrocarbons, Metals, Water pollution sources.

Storm-water runoff from operating highways can carry considerable quantities of pollutants, especially petroleum hydrocarbons and solids and metals, into the nation's receiving waters. The Federal Highway Administration, charged with the responsibility of protecting the environment from pollution from highway sources, has approached the problem in a multiphase research effort. The objective of the first phase was to identify and quantify the constituents of highway runoff. The next phase sought to identify sources and migration paths of these pollutants from the highways to receiving waters. The third phase, currently in progress, is analyzing actual impacts of highway runoff on receiving water. A wide variety of instrumentation has been used in the field monitoring portions of the investigation. Physical, chemical, and biological characterizations have been made. A general description of the types of equipment used in all three phases of the research program is presented. Special instrumentation and tests for source and migration studies include saltation catchers, zero-tension lysimeters, and sweeping and flushing. Saltation catchers were designed to capture saltating (moving by a series of jumps) particles form roadway surfaces. Zero-tension lysimeters measure groundwater percolation out of the major rooting zone. Sweeping and flushing studies were performed to quantify the accumultion and distribution of pollutants on the highway surface. (Moore-IVI)
W84-02228

LIFE HISTORY AND DISTRIBUTION OF THE ROANOKE BASS AMBLOPLITES CAVIFRONS COPE, IN VIRGINIA,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W84-02378

7. RESOURCES DATA

7A. Network Design

EFFECT OF SAMPLING UNCERTAINTY AND SPATIAL CORRELATION ON AN EMPIRICIAL BAYES PROCEDURE FOR COMBINING SITE AND REGIONAL INFORMATION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Journal of Hydrology, Vol. 65, No. 4, p 373-398, September, 1983. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Sampling, *Probabilistic process, Mathematical studies, Model studies, Spatial distribution, Hydrologic models.

The effect of sampling uncertainty and spatial correlation on the pooling of site and regional information is studied in the context of the empirical Bayes (EB) normal probability model, chosen because of its simplicity and generality. Because the EB model parameters must be evaluated from observed hydrologic data they are subject to uncertainty which can be considerable when samples are small and inter-site correlation exists. The procedures developed enable one to assess approximately the effect of uncertainty in these parameters. Hence, the gains that pooled inference can make over site or regional inference can be realistically evaluated and also the cases for which pooling of information is counteproductive can be identified. While the EB model assumes the sampling distribution and superpopulation are normally distributed, the results can be usefully employed in non-normal situations whenever a quadratic loss criterion is acceptable. In such instances, the EB procedure for pooling site and regional information is the best available one for the class of linear procedures with its risk being given by the pooled variance. (Baker-IVI)
W84-02457

7B. Data Acquisition

APPARATUS FOR SAMPLING OF STREAMS FOR CHEMICAL QUALITY AND SEDIMENT,
Jonkershoek Forestry Research Station, Stellenbosch (South Africa). Dept. of Environmental Affairs.
D. B. Van Wyk.
Water South Africa, Vol. 9, No. 3, p 88-92, July, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Sampling, *Streams, *Storm runoff, Monitoring, Measuring instruments, Costs, Automation, Bed load.

An apparatus was designed to automatically collect samples from streams during spates. The system enables stage samples to be taken during both the rise and recession of spates and functions on natural hydraulic pressures created by changes in stream level. A system for the measurement of bed load deposits that has been in use since 1978, is also described. These techniques have proved effective and cost is low when compared with other equipment marketed for similar purposes. The sampling record shows a success rate of 95% over two rainy seasons in the Western Cape (South Africa). The success/failure rate is reported for 5 catchments where the apparatus was well maintained. Blockages caused by debris, and air leaks are the only factors that cause sampling failure. (Baker-IVI)
W84-02308

TELEMETRY FOR MONITORING AND CONTROLLING WASTEWATER COLLECTION SYSTEMS,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and R. W. Graupmann.
Public Works, Vol. 114, No. 6, p 69-73, June, 1983. 3 Fig.

Descriptors: *Telemetry, *Monitoring, Wastewater collection, Remote sensing, Management.

The three principle methods of telemetry communications are telephone lines, radio, and microwave, each with its advantages and disadvantages. Telemetry systems have evolved from simple DC systems to tone systems to digital-based systems. Digital systems are economical for applications with as few as three of four signals per remote station. In applications requiring remote control as well as monitoring, digital technology is mandatory to provide the necessary level of security. Only a digital system offers the error checking and multiple transmission capabilities necessary for control system integrity. Microcomputers based systems, complete with CRT's and printers are available for relatively low capital investment. More sophisticated systems to regulate sewer flow are feasible and cost effective. (Baker-IVI)
W84-02359

DIRECT METHOD FOR FOREST TRANSPIRATION MEASUREMENT,
Stavebni Geologie, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2D.
W84-02461

MICROPROCESSOR-CONTROLLED PRECIPITATION DATA COLLECTION SYSTEM,
Idaho Agricultural Experiment Station, Moscow.
M. D. Burgess, and C. L. Hanson.
Journal of Hydrology, Vol. 66, No. 1-4, p 369-374, October, 1983. 2 Fig.

Descriptors: *Microprocessors, *Precipitation, *Meteorological data collection, Data storage and retrieval, Data acquisition, Rainfall, Computers.

A microprocessor system was developed that uses a removable memory module for precipitation gage data storage and retrieval. The system can be used in remote locations as the circuitry draws very little power. Precipitation data are entered directly from the removable memory module into a computer for data storage and analysis. This eliminates the need for recorder charts and manual data entry into a computer system. Detailed descriptions are offered of the precipitation gage, A/D converter, digital clock, four-digit display, I/O control logic, state code logic, microprocessor, removable memory module, and readout system. Storm event records were plotted from this system and a nearby standard weighing-recording precipitation gage to determine how well the record from this system compared with the catch from the standard weighing-recording gage. Analysis of the plots showed that the same amount of precipitation was recorded at the same time by the two gaging systems. (Baker-IVI)
W84-02476

7C. Evaluation, Processing and Publication

COMPUTER IMPROVES COMPOSITES,
South Dakota School of Mines and Technology, Rapid City.
L. L. Harms, and H. Smith, Jr.
Water Engineering and Management, Vol. 130, No. 12, p 39-40, November, 1983. 3 Fig.

Descriptors: *Computers, *Sample preparation, Water sampling, Hydrographs, Composite samples, Wastewater sampling.

A computer program has been developed to aid in determining the correct aliquots of a composite sample so that the sample will reflect the prope

proportions of various discrete water or wastewater samples. A flowchart of Program COMP4 is displayed. The program is designed to accept up to 100 data points on a hydrograph. Input data are time, flow, sample numbers, empty container weights, and container weights after sampling. A hydrograph from an urban watershed from which four discrete samples were collected is shown. (Baker-IVI)
W84-02370

8. ENGINEERING WORKS

8A. Structures

SOME RESULTS OF GENERALIZING AND ANALYZING THE EXPERIENCE OF ON-SITE OBSERVATIONS OF THE STATIC OF CONCRETE DAMS,
A. N. Marchuk.
Hydrotechnical Construction, Vol. 17, No. 2, p 68-70, February, 1983. 2 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 16-18, February, 1983.

Descriptors: *Concrete dams, *Dam construction, Safety monitoring, Construction, Design criteria, Costs, Stress, Deformation, Rock mechanics, USSR.

Data was gathered from on-site observations made during the last 20 years on 15 large dams in the USSR with an effort toward establishing a further improvement in the design of concrete dams and reducing their consumption of materials and cost. Owing to the absence of a unified method of siting and assembling the instruments, and processing and interrelating their readings and to the lack of a system of centralized collection of report data on observations of structures of the same type, generalization and analysis of the data was difficult. Repeated checks of the fulfillment of the conditions of invariance of stresses and measurements of deformations indicates a good degree of accuracy and reliability of on-site observations made by means of embedded string-type transducers. There was a low accuracy of string-type instruments in the range of small deformations and there is imperfection of the method for converting strains to stresses. Geodetic observations in recent years at large hydrostations have recorded substantial deformations of rocks at dam sites, with the formation of a settlement crater extending up to 3 km downstream, convergence of the banks, and sometimes movements of the bank slopes, suggesting the presence of a three-dimensional state of streams of the dams. The application of solutions of the two-dimensional problem to such dams is therefore quite conditional and can lead to inaccurate results. The stress state of the profiles of gravity and buttress dams during permanent operation is characterized by ubiquitous compression formed mainly under the effect of the dead weight and changes in the temperature of the air, concrete, and water in the upper part of the reservoir. The imperfection of the available instruments does not permit checking by direct measurement the design assumptions about the extent of certain main loads acting on dams. In gravity and buttress dams there occurs a low level of use of the strength properties of the rock foundations, concrete and reinforcing steel bars. The organization of on-site observations on hydraulic structures requires a radical improvement for obtaining a maximum cost effectiveness from eliminating the excess safety factors in the methods of calculating and designing dams. (Baker-IVI)
W83-02294

CALCULATION OF HYDRAULIC ELEMENTS OF STABLE SECTIONS OF LARGE CANALS IN FINE SANDS,
V. A. Skryl'nikov.
Hydrotechnical Construction, Vol. 17, No. 2, p 90-95, February, 1983. 1 Fig, 1 Tab, 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo No. 2, p 32-34, February, 1983.

Descriptors: *Sand, *Stability analysis, *Canal construction, Construction, Canals, Canal design, Design criteria, Flow velocity, Soil properties, Flow.

In order to calculate hydraulic elements of stable sections of large canals in fine sands the cross section of the large canal should have not only the necessary capacity, but also a fully determined planar stability both longitudinal and transverse. Longitudinal stability means a constancy of the planar position of the channel line, rectilinear or curvilinear. For conditions of canals it is expedient to distinguish the following types of longitudinal stability: static, achieved at a flow velocity corresponding to the noneroding velocity; transitional (from static to dynamic) or quasidynamic is characterized by the start of development of bed formations in the form of small and large ripples and preparation of the flow for transport of all particles of the bottom sediments; dynamic for a straight channel corresponding to hydraulic elements for which in the canal a certain amount of bottom sediment is transported in the form of large ripples and small ridges, preserving the rectilinearity of the flow in plan; and dynamic for a sinuous channel composed of cohesionless oils corresponding to hydraulic elements for which the flow in plan takes on a stable curvilinear shape, also transporting a certain amount of sediment as ridges. If the banks are composed of cohesive solid, then the rectilinearity of the channel in plan can be preserved due to nonerodibility of the banks, although the channel line will be curved relative to the axis of the channel of the canal. (Baker-IVI)
W83-02298

DESIGN OF MODELS FOR INVESTIGATING DYNAMIC PHENOMENA IN MECHANICAL EQUIPMENT OF HIGH-HEAD SPILLWAYS,
G. A. Chepaikin.
Hydrotechnical Construction, Vol. 17, No. 2, p 96-99, February, 1983. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 35-37, February, 1983.

Descriptors: *Spillways, *Design criteria, Model studies, Construction equipment, Mechanical equipment, Gates, Hydraulic models.

The interrelation of hydrodynamic phenomena in a spillway and in its metal linings, gates, and lifting mechanisms compels regarding such a spillway with gates and mechanisms as a single hydrodynamic system. Thus a model of the system must completely reproduce all essential structural members, loads acting on the members, and reactions of the members to these loads. A model for hydrodynamic investigations should in all details be geometrically, kinematically and dynamically similar to the prototype structure. This means that the design of the model should duplicate the calculation and design of the prototype structure. A model with its gauges serves for measuring various mechanical quantities characterizing the hydrodynamic proceses occurring in it. When designing and fabricating the model it is necessary to treat it as a measuring instrument, assessing and establishing the possibilities and errors of operation of each component. Since a single law of modeling for all phenomena does not exist, it is necessary to select a law or group of laws which is uniquely applicable to the maximum number of phenomena and to make the remaining phenomena obey this law by imposing special requirements on the design of the model. Such a most general modeling law is the condition of the joint similarity of the geometric dimensions of the structures and water depths in the pools of the prototype and model (the Froude similarity condition). Similarity should be maintained in all dimensions, both overall for the spillway and gates in detail as in the dimensions of individual sections of gates and their articulated joints, in the dimensions of the beams, plates, suspension, running gear, and sealing devices, in the gaps between the gate and embedded parts, in the bearings, and in the roughness of the surfaces exposed to the flow. It is necessary to maintain similarity of the masses and rigidities (deformations) of the structural members and also similarity of the forces acting on the mechanical system, including external forces and mechanical frictional forces. All dimensions must be examined not only in the design version but sometimes also for possible deviations in construction. (Baker-IVI)
W83-02299

CONCERNING THE USE OF A RELIABILITY COEFFICIENT IN CONSTRUCTION SPECIFICATIONS AND REGULATIONS AND THE CASUAL SEEPAGE STRENGTH OF FOUNDATIONS OF EARTH STRUCTURES,
S. M. Slisskii.
Hydrotechnical Construction, Vol. 17, No. 2, p 106-107, February, 1983. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 41-42, February, 1983.

Descriptors: *Hydraulic structures, *Safety, Construction, Regulations, Dams, Earth dams, Seepage, Reliability, Foundations.

The problem of calculating the reliability of hydraulic structures is complex and the development of acceptable generally recognized calculation methods requires considerable effort. When designing hydraulic structures the possibility of operating with quantitative reliability criteria at the same level as is found in a number of other areas of engineering is at present inaccessible for hydraulic engineering. Of particular importance is the problem of increasing the reliability of dams by taking into account chance factors such as the presence of concentrated seepage paths at the base of a structure or in the body of earth dams as a consequence of knowingly inferior performance of the works or as a result of errors in evaluating the properties of the nonrock earth foundation. Statistical data on constructed structures are used for determining the length of the seepage contour of concrete dams on earth foundations and the necessary certain average seepage path in the body of an earth dam. The reliability coefficient as used in the SNiPs (reliability of structures in the construction specifications and regulations) in no way gives an idea about reliability as a probabilistic quantity and in essence remains a factor of safety, which is a quantitative expression of the predominance of the generalized bearing capacity of the structure, structural member, and foundation over the generalized acting forces. The matter is not changed by the probabilistic determination of a certain type of loads. The term reliability coefficient in the SNiPs for hydraulic structures should be replaced by safety factor. The question of calculating earth foundations for casual seepage strength ought to be reexamined and this method of calculating be used only for making preliminary approximate decisions. (Baker-IVI)
W83-02301

INVESTIGATIONS OF THE KURPSAI DAM ON THE BASIS OF A NUMERICAL SOLUTION OF THE THREE-DIMENSIONAL PROBLEM OF ELASTICITY THEORY,
K. I. Dzyuba, and B. V. Fradkin.
Hydrotechnical Construction, Vol. 17, No. 2, p 71-80, February, 1983. 9 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 19-25, February, 1983.

Descriptors: *Elastic properties, *Concrete construction, *Gravity dams, *Mathematical studies, Theoretical analysis, Dams, Kurpsai Dam, Construction, Engineering, Concrete dams, Rock mechanics.

Progress made in the development of computing machinery and numerical methods of mechanics of solid deformable bodies has made it possible in a study of the Kurpsai Dam to proceed to a determination of the three dimensional work of the structure in an improved formulation. The following tasks were undertaken during the investigation: to refine the three-dimensional stress-strain state of the structure, particularly in the zone of contact with the foundation where tensile stresses acting from the upstream face perpendicular to the contact were noted; to examine various combinations of the external actions, including the seismic load, determined, according to the standard spectral method of construction specifications and regulations, by determining the frequencies and modes of

natural vibrations from the solution of two-dimensional problems of elasticity theory for cross sections of the dam; and to analyze the static behavior of the structure with consideration of possible opening of the vertical section joints. The stress-strain state of the concrete dam of the Kurpsai Hydrostation was determined by the finite-element method on the basis of solving the three-dimensional problem of elasticity theory modeling the dam and part of the rock mass surrounding it. The calculation was performed for the right bank part of the dam on the assumption of symmetry of the structure. The PROZA computer complex was used to solve the three-dimensional problem. Opening of the section joints is a possible consequence of gradual cooling of the concrete masonry. Careful on-site observations of the state of the joints is needed for their timely grouting. The numerical model of the structure developed during conduction of the works presented can be used for analyzing the data of on-site observations. (Baker-IVI)
W84-02295

CLEANING AND LINING OLD WATER MAINS SAVES MILLIONS FOR MASSACHUSETTS COMMUNITY,
Camp, Dresser and McKee, Inc., Boston, MA.
R. Cutone.
Public Works, Vol. 114, No. 3, p 70-71, 96, March, 1983. 1 Fig, 1 Tab.

Descriptors: *Water mains, *Linings, Maintenance, Water conveyance, Pipelines, Costs, *Massachusetts, *New Bedford.

Maintaining adequate water pressure during daily peak demand conditions is a matter for concern in any distribution system. New Bedford, an old seaport community 60 miles south of Boston, is a city of about 100,000 supporting many industrial and commercial enterprises. The public water system has been in existence since 1869 while the limits of the system as it exists today have remained unchanged since the 1930s. An annual system of cleaning and cement lining of unlined cast-iron water mains with the ultimate goal of having cement-lined pipes throughout the system was begun in the 1970's. As a measure of the over $4-million savings the city has seen, the following analysis was made. Using the actual costs incurred by the city for each year's program and estimates of costs for construction of new cement lined ductile iron pipe of comparable diameters and lengths, the net savings to New Bedford was developed. Using the same information, a ratio of cleaning and lining costs versus cost to construct new mains was determined to be 2.74. (Baker-IVI)
W84-02352

8B. Hydraulics

PREDICTION OF CHANNEL BED GRADE CHANGES AT HIGHWAY STREAM CROSSINGS,
S. A. Brown.
Transportation Research Record, No. 896, p 1-7, 1983. 2 Fig, 2 Tab, 31 Ref.

Descriptors: *Bridges, *Grading, Mathematical models, Channels, Highways, Model studies, Aggradation, Scouring.

Changes in channel bed-level elevation associated with channel aggradation and degradation have been found to be a significant cause of hydraulic problems at bridges. Numerous techniques for evaluating the impact of these grade changes, from simple, qualitative geomorphic principles to complex, fully developed, computer models, are available in the literature. These techniques represent a wide range of levels of analysis data needs, difficulty of application, time requirements, and costs. The number of techniques available and the variety in their levels of accuracy emphasize the need to base gradechange predictions on more than one technique or model. An appropriate procedure starts with general observations and the evaluation of geomorphic principles and relations to establish the cause and direction of the change and is then built on by applying some of the simpler quantitative techniques. From this base, one or more of the levels of mathematical modeling can be applied. The level of sophistication used in the modeling process should be based on the physical processes causing the grade change, the economic importance of the particular crossing, and available time, manpower, and financial resources. (Author's abstract)
W84-02221

STREAM CHANNEL GRADE CHANGES AND THEIR EFFECTS ON HIGHWAY CROSSINGS,
S. A. Gilje.
Transportation Research Record, No. 896, p 7-10, 1983. 6 Fig, 12 Ref.

Descriptors: *Aggradation, *Degradation, *Channels, *Streambed, *Highway effects, *Bridges, Sedimentation, Sediment transport, Geomorphology, Rivers, Streams.

Stream channel degradation and aggradation are significant hydraulic problems at river crossings. Degradation is lowering of the streambed, independent of scour caused by obstructions or constructions. Rapid or long-term degradation is usually due to a significant change in normal sediment-transport relations. Aggradation is stream infilling and occurs when more sediment is supplied to a stream than the stream is capable of transporting. Problems caused by stream degradation are far more common than those caused by aggradation. If actions are to be taken to protect a highway crossing against grade changes, early recognition of these hazards is imperative. Techniques for determining whether a crossing is experiencing degradation or aggradation are observation of stream characteristics (geomorphology), anticipation of gradation changes based on watershed activities, and measurement of pertinent stream dimensions. Streams in areas of high sediment yield are most prone to grade changes. Severe grade changes are often due to human intervention in natural stream processes. The problems associated with degradation and aggradation warrant special attention because protective measures effective against local hydraulic hazards are ineffective for protection against grade changes. (Author's abstract)
W84-02229

NONSTATIONARY CHANNEL DEFORMATIONS NEAR OBSTACLES,
Institute of Railroad Transportation Engineers, Moscow (USSR).
Yu. L. Peich.
Water Resources, Vol. 10, No. 1, p 66-70, January-February, 1983. 2 Fig, 7 Ref. Translated from Vodnye Resursy, No. 1, p 108-112, January-February, 1983.

Descriptors: *Channels, *Flow, *Channel deformation, Mathematical studies, Model studies, Hydraulic structures, Construction, Scour, Flow around objects.

Local deformations of a channel due to changes in the kinematic structure to the flow near an obstacle have a considerable effect on the operating conditions of hydraulic structures. An attempt is made to further develop the relations of the instantaneous bed-load discharge in the scour zone on the depth of local channel deformations and the exponential dependence of the bed load discharge on time by determining the appropriate dependences of the maximum discharge in the scour pocket and sediment discharge gradient on the hydraulic parameters of the flow. (Baker-IVI)
W84-02346

8C. Hydraulic Machinery

METHODS AND MEANS OF AUTOMATED MONITORING OF THE STATE OF HYDRAULIC STRUCTURES DURING THEIR OPERATION,
D. B. Radkevich.
Hydrotechnical Construction, Vol. 17, No. 2, p 59-67, February, 1983. 4 Fig, 1 Tab, 7 Ref. Translated from Gidroteknicheskoe Stroitel'stvo, No. 2, p 11-16, February, 1983.

Descriptors: *Monitoring, *Hydraulic structures, *Electrical equipment, Mechanical equipment, Automation, Powerplants, Computers.

A number of string transducers have been developed and are being manufactured for prompt remote monitoring of the state of structures and automation of monitoring operations. String transducers are finding their most effective use when measuring settlement, horizontal displacement, levels of the depression surface, discharges in collector drains, and deformation of the expansion, settlement, and horizontal joints in structures. Automation of these measurements substantially simplifies the use of computers for data processing and gives the operating personnel prompt information about the state of structures and their foundation. The transducers, together with traditional nonelectrical means of monitoring the state of structure, form remote measuring systems. The systems monitoring the state of the structures can be of three types, differing in level of automation: remote systems with cables leading from the transducers to the KP-24 cummulator switches and with measurement of the signals by means of the PTsP-1 portable digital periodometer; centralized systems with automated collection and digital recording of the measurement data by means of teletypewriter tape punch; and automated information measuring systems based on control computer complexes performing real-time data processing. Remote monitoring of the settlement of structures and foundations and observations of deflections or reinforced concrete structural members are accomplished by means of a hydrostatic leveling system constructed with the use of type PUZhS liquid-level transducers. The mass production of string transducers makes it possible to equip large operating hydrostations with them and to envisage the creation of automated systems for monitoring structures during operation when designing new facilities. (Baker-IVI)
W83-02293

8D. Soil Mechanics

MODELING IN TESTS OF COARSE-FRAGMENTAL SOIL OF THE ZARAMAG DAM,
O. A. Pakhomov.
Hydrotechnical Construction, Vol. 17, No. 2, p 80-84, February, 1983. 3 Fig, 2 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 25-28, February, 1983.

Descriptors: *Dam construction, *Soil properties, Model studies, Construction, Design criteria, Petrography, Mineralogy, Rock fill, Zaramag Hydroelectic Station.

A correct determination of the characteristics of gravel-pebble mixtures, rock mass, and rock fill is exceptionally important in the construction of earth structures for large power installations and the preparation of foundations for power units of thermal and nuclear power stations as these characteristics affect the selection of an economical design for the structure, the effective technology of its construction and the duration of trouble-free operation of the structure. An example is offered of a modeling method used when substantiating the design characteristics of coarse-fragmental material for the dam at the Zaramag hydroelectric station. The given conditions of modeling when testing coarse-fragmental soils makes it possible to cover a wide range of prototype particle-size distributions of construction soils practically without limiting the content of fine and coarse-grained fractions in them. When testing prototype soils or their model mixtures it is recommended to determine the allowable size of the fractions in relation to the size of the laboratory device and the granularity of the tested material. The modeling conditions call for composing several model mixtures, compaction of the samples to the same projected relative density, laboratory or field testing, and conversion from the results obtained to the characteristics of the coarse fragmental soils of the prototype composition. The most important distinctive feature of the given

model method is the integral consideration of the significant factors affecting the physical and mechanical characteristics being determined. Such fractors include petrographic and mineralogical composition, specific weight, strength, shape and size of the particles, surface roughness and others. This increases the accuracy of the test results compared to methods which specify an investigation of one model mixture and which are forced to take into account and aforementioned factors by various hypotheses and assumptions. (Baker-IVI)
W83-02296

CALCULATION OF HYDRAULIC ELEMENTS OF STABLE SECTIONS OF LARGE CANALS IN FINE SANDS,
For primary bibliographic entry see Field 8A.
W83-02298

CONCERNING THE USE OF A RELIABILITY COEFFICIENT IN CONSTRUCTION SPECIFICATIONS AND REGULATIONS AND THE CASUAL SEEPAGE STRENGTH OF FOUNDATIONS OF EARTH STRUCTURES,
For primary bibliographic entry see Field 8A.
W83-02301

COMPACTION PROCEDURES, SPECIFICATIONS, AND CONTROL CONSIDERATIONS,
E. T. Selig.
Transportation Research Record, No. 897, p 1-8, 1983. 4 Fig, 24 Ref.

Descriptors: *Soil compaction, *Soil mechanics, *Earthworks, Construction, Compaction tests, Soil density, Soil water.

Compaction is the process of soil densification by mechanical manipulation. The reason for compacting is to improve soil properties such as increasing strength, decreasing compressibility, decreasing permeability, and reducing swelling and shrinkage. Factors that influence field compaction results include soil type, method of preparation, uniformity of procedures, environmental influences, roller type, compactive effort, lift thickness, underlying layer, and rate of compaction. Variability of density from point to point in the field is sufficiently large that compliance of 100% of compaction tests with a specified compaction requirement is unfeasible and unreasonable to expect. Variability is significant, with a typical standard deviation of density scatter being 4 to 6 lb/ft. Modification of moisture content is rarely required for construction unless density results are unsatisfactory. As normally practiced, testing is insufficient for reliable judging of compaction. (Moore-IVI)
W84-02230

EMBANKMENT COMPACTION AND QUALITY CONTROL AT JAMES BAY HYDROELECTRIC DEVELOPMENT,
J.-J. Pare, B. Boncompain, J.-M. Konrad, and N. S. Verma.
Transportation Research Record, No. 897, p 8-15, 1983. 10 Fig, 3 Tab, 5 Ref.

Descriptors: *Embankments, *Dykes, *Soil compaction, Earthworks, Earth dams, Rockfill dams, Dam construction, Quality control, La Grande Complex, James Bay, Quebec.

Construction of 220 dams and dykes at the La Grande Complex, James Bay (Quebec) hydroelectric development involves several types of materials (till, sand and gravel, and rockfill) and construction procedures and equipment that must yield embankment zones of desired characteristics. Experience and design requirements, as well as the schedules, economic, and climatic restraints, have led to a general standarizat..n of the specified material placement techniques and conditions. The specification have developed along the following lines: designation of borrow areas; product specifications for materials; and procedure specification for fill placement. Quality control includes both visual inspection and laboratory testing of materials at the borrow areas as well as on the fill. Visual inspection to control material, equipment, procedure, and product is of utmost importance because it permits a repid and general evaluation of the quality of work, particularly of the embankment homogeneity. Three categories of tests are performed: grain-size analyses and water content determination (carried out at a rate of about 1/5000 cu m or 1/day and 1/1000 cu m, respectively) for a quick verification of the conformity of materials to specifications; measurement of field densities and reference or target densities on a regular basis with a frequency of about 1/5000 cu m or 1/day to monitor uniformity of fill placement; and determination of permeability, comperssibility, and strength characteristics of the embankment materials, carried out annually to verify the conformity of the material properties with the design assumptions. Typical properties of the embankment materials based on extensive tests carried out on 160 Mm3 of materials are included. (Moore-IVI)
W84-02231

COMPACTION PRACTICE FOR DAM CORES AT HYDRO-QUEBEC,
O. Dascal.
Transportation Research Record, No. 897, p 60-71, 1983. 15 Fig, 1 Tab, 3 Ref.

Descriptors: *Soil compaction, *Glacial till, Earth dams, Rockfill dams, Quebec, Clay, Water content, Soil water, Construction, Dykes, Dam cores.

Glacial till is used mainly as an impervious material in earth and rockfill dams built in Quebec. It is, in general, a well-graded mixture of sand, silt, and gravel, with 25-80% passing the no. 200 sieve and a natural water content at or above optimum (Proctor standard). Its natural water content, together with its very high sensitivity to atmospheric humidity, strongly influence the choice of compaction equipment, compaction procedure, and time schedule. Hydro-Quebec's experience with this type of material, including choice of the compaction equipment, establishment of the compaction procedure, pretreatment of the borrow pit material, as well as the results and performances obtained at various sites are presented, based on three case histories. The first project used a till that had a natural water content at or slightly above its optimum, and hence presented no problem of placement or compaction. In the second project, the use of a till that had a natural water content substantially higher than optimum created a set of difficult problems and necessitated the adoption of new solutions. A third example illustrates the use of a highly sensitive marine clay as core material, its placement, and compaction problems experienced during the construction of an earth-fill dike located in the St. Lawrence valley. (Moore-IVI)
W84-02232

8E. Rock Mechanics and Geology

SOME RESULTS OF GENERALIZING AND ANALYZING THE EXPERIENCE OF ON-SITE OBSERVATIONS OF THE STATIC OF CONCRETE DAMS,
For primary bibliographic entry see Field 8A.
W83-02294

PREDICTION OF GAS SHOWS IN UNDERGROUND WORKINGS (EXEMPLIFIED BY THE NUREK HYDROELECTRIC STATION),
N. F. Lomonosov, and L. A. Mikhaleva.
Hydrotechnical Construction, Vol. 17, No. 2, p 100-102, February, 1983. 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 37-38, February, 1983.

Descriptors: *Hazards, *Tunneling, *Gases, Construction, Tunnel construction, Tunnels, Safety, Earthquakes.

The liberation of gas from rocks in underground workings complicates tunnel operations to varying degrees. The low degree of reliability found in predicting where gas is and the characteristics of the gas is due both to the complex character of the distribution of gases in rocks and to the insufficient study of gas. Analyses of gas encounters suggest that weak gas shows in underground workings can create local gas pollution exceeding the permissible levels, particularly during earthquakes. With existing survey methods the complex distribution of gases in rocks and their variable composition and flow rates preclude their reliable prediction. To ensure the safety of tunneling operations it is necessary to systematically monitor the composition of the mine atmosphere with consideration of possible gas reservoirs (especially of the fissure-vein type), even in those cases when according to the survey data there is no information on expected gas shows. During engineering-geological surveys and documentation of underground working it is necessary to take into account, in the working hypothesis of the geological structure of the rock masses, the broad possibility of the penetration of deep gases with harmful components to various levels, right up to the surface. A comprehensive study of gas shows detected in tunnels is needed in order to create reliable methods for predicting these shows and for purposeful monitoring of the mine atmosphere. (Baker-IVI)
W83-02300

IDENTIFICATION OF SOURCE MATERIALS FOR ACID LEACHATES IN MARYLAND COASTAL PLAIN,
For primary bibliographic entry see Field 5B.
W84-02219

CHEMICAL COMPOSITION OF NATURAL WATERS AND ROCK WEATHERING IN THE IZU PENINSULA AREA AS AN INDEX TO EARTHQUAKE-CAUSED LANDSLIDES,
Miyasaki Univ. (Japan). Dept. of Civil Engineering.
Y. Kitano, S. Nakamura, M. Takemura, and K. Majima.
Japanese Journal of Limnology, Vol. 44, No. 3, p 155-172, July, 1983. 9 Fig, 3 Tab, 11 Ref.

Descriptors: *Chemical composition, *Landslides, *Natural waters, *Izu Peninsula, *Japan, *Earthquakes, Rockslides, Rocks, Weathering, Limnology, Minerals, Carbonates, Sulfates.

The possibility that the chemical composition of natural water may be related to the occurrence of earthquakes is considered. Natural waters of the Izu Peninsula (Japan) area were used for the study. The natural waters in the southern part of the peninsula and in the Inatori area exhibited very high concentrations of dissolved constituents. These waters flow out through a fault. A calcium chloride type water was also found in Izu Peninsula in a typical fault area. No relationship was determined between earthquakes and the chemical composition of natural waters. However, from the chemical composition of natural waters, the amount of rock forming minerals chemically weathered and also the amount of clay minerals formed were estimated. The formation of clay minerals greatly decreases ground stability. The dissolution of silica has little influence as compared with the formation of clay minerals, but the carbonate dissolution has a significant role. The concentration of carbonates plus sulfates in the natural waters in Izu Peninsula may well indicate the degree of ground stability in the area and thereby predicts the size and extent of landslides. Estimation of the amounts of clay minerals formed and rock forming minerals weathered is thus valuable and useful for the prediction and prevention of earthquakes disasters. (Baker-IVI)
W84-02477

8F. Concrete

EXPERIENCE IN GROUTING CONCRETE UNDER CONDITIONS OF THE FAR NORTH,
Yu. D. Chertykov, and M. M. Dzhuraev.
Hydrotechnical Construction, Vol. 17, No. 2, p 108-111, February, 1983. 2 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 45-47, February, 1983.

Group 8F—Concrete

Descriptors: *Grouting, *Abutments, *Cold weather construction, *Concrete, Construction, Cold regions, Permeability, Drilling.

A new grouting technology was employed at a hydraulic structure located in the Far North, shortening the duration of the work considerably. Destruction of the concrete surface of abutments had occurred and seepage of water through the body of the abutments and around the embedded parts of the support contour of the gate was increasing. A number of research holes were planned for drilling over the entire height of the abutments to check the condition of the concrete masonry in the inner parts. These holes showed that the concrete was in unsatisfactory condition and its various areas had a different degree of preservation and permeability. In order to repair the structure it was decided to inject the entire mass of concrete into the abutments. Four rows of vertical holes were drilled so that they covered the concrete, especially in the upper part and edge regions of the abutments. Drilling of the holes and injection of the stabilizing slurries were carried out in three phases in descending 5-m zones at an injection pressure of 3-5 atm in the first zone and 8-10 atm in the subsequent ones. The applicability of the grouting and resin impregnation methods was established by hydraulic testing. It was decided to dispense with resin impregnation as a complex and labor intensive method of sealing concrete and to use only grouting. The following new technology was developed: to simultaneously drill holes of all phases to the complete design depth over the entire abutment, during drilling to carefully record the condition of the concrete on the basis of the rate of penetration, core recovery, its preservation and the consumption of water for flushing the holes. Hydraulic testing was carried out in all holes to determine the permeability of the concrete. All visible outflows of the water were eliminated by sealing with thick cement-sand mortar with the addition of sodium silicate. Before starting, steam from the works was fed for 1 hr into the hole through a pipe or hose lowered to the bottom of the hole. The cement slurry was prepared with warm water and bentonite in an amount of 5% of the weight of the cement was added to it to increase the stability of the slurry. Grouting began with the holes having minimum specific water absorption, gradually proceeding to holes with greater specific water adsorption. Holes with large adsorption of cement are left to settle then drilled out and grouted again. (Baker-IVI)
W83-02302

8G. Materials

CORROSION AND SCALE INHIBITORS FOR WATER DISTRIBUTION SYSTEMS,
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5F.
W84-02361

VERSATILE ASPHALT: LAGOON AND RESERVOIR LINER,
National Asphalt Pavement Assoc., Riverdale, MD.
C. Crawford.
Water Engineering and Management, Vol. 13, No. 12, p 30 and 32-33, November, 1983. 2 Fig.

Descriptors: *Asphalt, *Linings, *Reservoir linings, Landfills, Reservoirs, Cement, Ponds, Lagoons, Retention ponds, Water storage.

The earliest known use of asphalt was to seal ponds and baths nearly 5000 years ago. Among the pond type appliactions of asphalt are: sewage lagoons, water storage reservoirs, landfill liners, brine lagoons, and retention ponds, all with the primary objective of retaining materials in storage and preventing seepage of the stored material into the soil groundwater system. No material found thus far can match asphalt tor its unique combination of the properties of stength, durability, flexibility, resistance to many hazardous materials and pollutants, and its impermeability. In landfills in Pennsylvania, hot mix asphalt has been used extensively as a liner for more than 10 years. The type of asphalt mix used is normally similar to a paving asphalt mix with 1/2 in. maximum size. The asphalt cement content is higher (perhaps 7-8% compared with about 55% for highway mixes) which renders the mix more workable, easier to compact on slopes and less permeable. A final seal of AC 20 grade asphalt cement applied at the rate of 0.25 gal/sq yd is recommended. (Baker-IVI)
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AT URBANA-CHAMPAIGN

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 17, NUMBER 8
AUGUST 1984

W84-02480 -- W84-02950

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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Please use the edge index on the back cover to locate Subject Fields and Indexes.

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Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

WATER TRANSFER COEFFICIENT IN ADSORPTIVE POROUS BODY,
Kyoto Univ. (Japan). Dept. of Chemical Engineering.
R. Toei, H. Imakoma, H. Tamon, and M. Okazaki.
Journal of Chemical Engineering, Vol. 16, No. 5, p 364-369, October, 1983. 7 Fig, 1 Tab, 9 Ref. Japanese Ministry of Education, Science and Culture grant 555377.

Descriptors: *Water transport, *Porosity, Porous media, Adsorption, Capillary water, Water vapor.

Water transport in wet porous materials is expressed as the simultaneous transport of adsorbed water, capillary water and water vapor. The sum of the surface flow coefficient and the liquid water transfer coefficient is defined as the water transfer coefficient in this report. The water transfer coefficient was measured by a modified method which is a kind of constant volume method for adsorption equilibrium. An activated alumina whose pores are fine was used as the experimental material. This method appears to be a simple experimental one to measure the water transfer coefficient, which represents the sum of transport of surface flow and liquid water in a short period using an easy but strict analysis. This coefficient in the range over a few orders of magnitude was measured by changing only the sample length. The results of experiments at temperatures of 30 to 50 degrees C could be well interpreted by the model described. (Baker-IVI)
W84-02797

2. WATER CYCLE

2A. General

IMPROVED PARAMETER INFERENCE IN CATCHMENT MODELS; 1. EVALUATING PARAMETER UNCERTAINTY,
G. Kuczera.
Water Resources Research, Vol. 19, No. 5, p 1151-1162, October, 1983. 12 Fig, 4 Tab, 33 Ref.

Descriptors: *Hydrologic models, *Catchment areas, *Statistical models, Runoff, Soil water, Model studies, Stochastic process.

A Bayesian methodology is developed to evaluate parameter uncertainty in catchment models fitted to a hydrologic response such as runoff, the goal being to improve the chance of successful regionalization. The catchment model is posed as a nonlinear regression model with stochastic errors possibly being both autocorrelated and heteroscedastic. The end result of this methodology, which may use Box-Cox power transformations and ARMA error models, is the posterior distribution, which summarizes what is known about the catchment model parameters. This can be simplified to a multivariate normal provided a linearization in parameter space is acceptable; means of checking and improving this assumption are discussed. The posterior standard deviations give a direct measure of parameter uncertainty, and study of the posterior correlation matrix can indicate what kinds of data are required to improve the precision of poorly determined parameters. Finally, a case study involving a nine-parameter catchment model fitted to monthly runoff and soil moisture data is presented. It is shown that use of ordinary least squares when its underlying error assumptions are violated gives an erroneous description of parameter uncertainty. (Author's abstract)
W84-02760

IMPROVED PARAMETER INFERENCE IN CATCHMENT MODELS; 2. COMBINING DIFFERENT KINDS OF HYDROLOGIC DATA AND TESTING THEIR COMPATIBILITY,
G. Kuczera.
Water Resources Research, Vol. 19, No. 5, p 1163-1172, October, 1983. 11 Fig, 7 Tab, 12 Ref, 2 Append.

Descriptors: *Hydrologic models, *Catchment areas, *Runoff, Mathemetical models, Statistical methods, Rainfall-runoff relationships, Bayesian methodology.

Some of the parameters of catchment models fitted to runoff data are often poorly determined, thereby making the task of developing useful regionalization relationships more difficult. The approach taken here is based on the notion that the information in a rainfall-runoff record can be supplemented by observations of other hydrologic responses such as soil moisture and field studies of hydrologic responses such as interception. The Bayesian methodology is extended to utilize several kinds of hydrologic data in parameter inference, the goal being to improve the precision of poorly determined parameters. The concept of compatibility is developed using statistical hypothesis tests. Different kinds of data are said to be compatible if differences between their fitted parameters are not statistically significant. A hierachy of three levels of information is introduced to enable systematic checking for compatibility. The compatibility tests, posed as statistical hypothesis tests, check whether differences between parameters inferred from different kinds of data are statistically significant. Application of this methodology to a case study indicates that the precision of poorly determined parameters fitted to runoff data can be substantially improved when runoff data are pooled with other kinds of hydrologic data. Before pooling different kinds of data (including split samples) it is essential to check their compatibility. When incompatible data are pooled, the ability of the catchment model to predict runoff can be undermined and also biases can be induced in the inferred parameters. (Moore-IVI)
W84-02761

SOME ALGORITHMS FOR PARAMETER ESTIMATION IN WATER RESOURCES SYSTEMS,
Louisiana State Univ., Baton Rouge. Dept. of Mechanical Engineering.
H. Sehitoglu.
Water Resources Research, Vol. 19, No. 5, p 1193-1202, October, 1983. 9 Fig, 23 Ref.

Descriptors: *Mathematical models, *Parameter identification, Model studies, Simulation, Finite-element models.

Many of the existing parameter identification schemes employ off-line algorithms, and so cannot be used in real-time applications. The problem of on-line parameter identification in some water resources systems was successfully resolved by developing proportional and proportional plus integral type algorithms. Lyapunov's stability theorem was applied to obtain recursive adjustment equations. This approach guarantees the convergence of the identification process. The proposed algorithms can identify unknown parameters of linear and nonlinear models. The application of the method depends on the selection of several algorithmic variables, such as gain constants, filter cutoff frequency, finite-element size, etc. Simulation studies indicated that the method is convergent for a wide range of gain values. The filter frequency usually affects the identification response time. Low values of the frequency result in sluggish output, whereas high values may produce undesirable large oscillations. In general, decreasing the finite-element size improves the final accuracy. To further enhance the accuracy, higher-order finite-element basis functions may be used in obtaining the finite-element models. (Moore-IVI)
W84-02763

AGGREGATION AND ESTIMATION FOR LOW-ORDER PERIODIC ARMA MODELS,
Colorado State Univ., Fort Collins. Dept. of Recreation Resources.
A. V. Vecchia, J. T. Obeysekera, J. D. Salas, and D. C. Boes.
Water Resources Research, Vol. 19, No. 5, p 1297-1306, October, 1983. 10 Fig, 6 Tab, 8 Ref. NSF grant CEE-8110782.

Descriptors: *Hydraulic models, *Seasonal variation, Estimating, Aggregates, Statistical studies, Time series analysis.

An aggregation approach is presented in which the seasonal time series is modeled and then aggregated, producing a specified compatible model for the aggregated series. The assumed periodic (seasonal) model is defined and the resulting aggregated model is derived. Parameter estimation is considered and some results on the goodness, as quantified by bias and variance, of the proposed estimators are given. A significant gain in the precision of the estimators at the aggregated level is noted when the seasonal data and its model are used as opposed to the aggregated (annual) data and its model. (Baker-IVI)
W84-02769

RELIABILITY OF CALIBRATION OF A MONTHLY RAINFALL-RUNOFF MODEL: THE SEMIARID CASE,
Rhodes Univ., Grahamstown (South Africa).
A. H. M. Gorgens.
Hydrological Sciences Journal, Vol. 28, No. 4, p 485-498, December, 1983. 6 Fig, 4 Tab, 12 Ref.

Descriptors: *Rainfall-runoff relationships, *Semiarid lands, *Mathematical models, Streamflow, Ecca basin, South Africa, Precipitation, Surface water, Calibration.

A monthly conceptual rainfall-runoff model that enjoys fairly widespread use in South Africa was calibrated for each of 50 calibration samples of lengths 3-20 years, drawn from a synthetic 101-year semiarid streamflow time series generated with the Stanford Watershed Model. The ability of Pitman's model to reconstruct the original 101 years of monthly streamflow for each of the 50 calibrations was then examined against a set of statistics of monthly and annual streamflows. The variabilities of key model parameters associated with different lengths of calibration period were also investigated. It is well worthwhile to increase the calibration period to about 15 years in order to reduce errors in reconstructed flow statistics. Merely increasing the length of calibration period from 6 to 10 years may decrease the error in most regenerated flow statistics by 30-50%. A fair amount of variability in 'optimum' parameters, however, seems unavoidable, even at longer calibration periods, though this may also partly be due to imperfect model calibration. The effects of this variability are greatly attenuated in the reconstructed flow statistics due to parameter interdependence. (Author's abstract)
W84-02827

REFLECTIONS ON RIVERS, RESEARCH, AND ROUSE,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
J. F. Kennedy.
Journal of Hydraulic Engineering, Vol. 109, No. 10, p 1254-1271, October, 1983. 5 Fig, 28 Ref.

Descriptors: *River flow, *Hydraulic models, Hydraulic roughness, Sediment discharge, Hydraulic engineering, Mathematical models, Friction, Channel flow, Water temperature, Computer models.

The ways in which rivers adjust their hydraulic roughness to accommodate only loosely correlated changes in their water and sediment discharges are discussed. An assessment of the current status of river engineering leads to the conclusion that the major deficiencies of mathematical models of river flow have been their failure to represent the dependence of friction factor on sediment discharge or concentration, and to include temperature and channel-curvature effects. It is argued that the data

and computational resources now are at hand to permit development of more inclusive analyses of alluvial-channel flow. A recently developed computer-based predictor for river-flow sediment discharge and friction factor, and an analytical model of flow in river ends are outlined. Reflections on Rouse's research and writing conclude the paper. (Author's abstract)
W84-02863

THE USE OF AUTOCORRELATION AND SPECTRAL ANALYSES TO OBTAIN A BETTER UNDERSTANDING OF HYDROLOGICAL SYSTEMS (POUR UNE MEILLEURE CONNAISSANCE DES SYSTEMES HYDROLOGIQUES A PARTIR DES ANALYSES CORELATOIRE ET SPECTRALE),
Centre National de la Recherche Scientifique, Moulis (France). Lab. Souterrain.
A. Mangin.
Journal of Hydrology, Vol. 67, No. 1-4, p 25-43, 1984. 8 Fig, 1 Tab, 37 Ref.

Descriptors: *Karst hydrology, *Hydrologic systems, *Autocorrelation, *Spectral analysis, Pyrenees, France, Spain, Rainfall, Hydrologic cycle, Discharge hydrographs.

Using the correlogram and variance spectral density, the time series of rainfall and discharge of a hydrological system are analysed in a descriptive way differing from the traditional method. From a methodological viewpoint some computational working choices are made. Applied to three karstic systems in the Pyrenean Mountains (France-Spain), these analyses permitted a comparison and a study of the different reactions of these three systems. They showed the presence of memory effects which modulated the input rainfall for short, medium and long term. These modulations characterize each system. They reflect the storages and the manner in which these fill and empty, thus indicating the karstification of the aquifer. The examples discussed indicate that these analyses provide an excellent method for the investigation of a hydrological system. (Author's abstract)
W84-02884

OVERLAND FLOW ON CONVERGING AND DIVERGING SURFACES - KINEMATIC MODEL AND SIMILARITY SOLUTIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
S. Y. Campbell, J.-Y. Parlange, and C. W. Rose.
Journal of Hydrology, Vol. 67, No. 1-4, p 367-374, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Model studies, *Surface runoff, *Overland flow, Kinematics, Cones, Steady state flow, Mathematical equations, Rainfall, Rainfall-runoff relationships.

An understanding of the process of surface runoff is vital in areas such as watershed hydrology and soil erosion. Through the re-examination of kinematic flow on a converging surface, a new method of solution has been found in the form of a similarity solution, reducing the problem to a first order ordinary differential equation which can be integrated easily by standard Runge-Kutta integration. When this method is applied to the geometry of a cone, an exact analytical solution is found which represents the steady state flow regime. This provides a check for numerical solution procedures used, which are found to be very accurate. (Baker-IVI)
W84-02903

2B. Precipitation

LONG-TERM VARIATIONS IN THE SOUTHERN OSCILLATION, EL NINO, AND CHILEAN SUBTROPICAL RAINFALL,
Oregon State Univ., Corvallis. School of Oceanography.
W. H. Quinn, and V. T. Neal.
Fishery Bulletin, Vol. 81, No. 2, p 363-374, April, 1983. 3 Fig, 6 Tab, 39 Ref. NSF grant ATM-7820419, NOAA contract NA-80-RAC-00003.

Descriptors: *Rainfall, *Climatology, Climate, Chile, South America, Southern Oscillation, El Nino, Variability, Subtropic zone, Climatic zones, Fisheries.

In order to better understand the causes and variations of Southern Oscillation-related activity, a 120 year record of the activity along the west coast of South America was studied. Significant decreases in the frequency of occurrence of moderate/strong El Ninos and the related abnormally heavy amounts of Chilean subtropical rainfall were noted over the past half century. A significant change took place between 1927 and 1931. A significant decrease in average annual rainfall was noted over subtropical Chile after 1944. Below normal pressures in the southeast Pacific subtropical high over the past 6 years coincide timewise with generally above normal sea surface temperatures over this region. An associated weakening of the southeast trade system is hypothesized to be responsible for environmental changes that contribute to the large alteration in composition of the pelagic biomass in both the Peruvian and northern Chilean fishery regions over recent years. (Baker-IVI)
W84-02645

CHARACTERISTICS OF THE BERGSCHRUND OF AN AVALANCHE-CONE GLACIER IN THE CANADIAN ROCKY MOUNTAINS,
Calgary Univ. (Alberta). Dept. of Geology and Geophysis.
G. Osborn.
Journal of Glaciology, Vol. 29, No. 101, p 55-69, 1983. 16 Fig, 7 Ref. Canadian N.S.E.R.C. grant A9026.

Descriptors: *Glaciers, *Bergschrund, Snow, Ice, Crevasses, Mount Chephren, Alberta.

Field study of the bergschrund of a small avalanche-cone glacier at the base of Mt. Chephren, in Banff National Park, has been carried out as part of a general exploratory study of glacier-head crevasses in the Canadian Rockies. The bergschrund consists of a wide, shallow, partly bedrock-floored gap, underneath which extends a nearly vertical Randkluft, and a small, offset, subsidiary crevasse (or crevasses). The following observations regarding the behavior of the bergschrund and ice adjacent to it are of particular interest: (1) topography of the subglacial bedrock is a control on the location of the main bergschrund and subsidiary crevasses, (2) the main bergschrund and subsidiary crevasse(s) are connected by subglacial gaps between bedrock and ice; the gaps are part of the 'bergschrund system', (3) snow/ice immediately down-glacier of the bergschrund system moves nearly vertical downward in response to rotational flow of the glacier, allowing the bergschrund components to keep the same location and size from year to year, (4) an independent accumulation, flow, and ablation system exists in the snow/ice up-glacier of the bergschrund system, (5) most of the void space in the bergschrund system is maintained through the winter, although the wide, shallow part of the main bergschrund fills up with snow, (6) some mass transfer of snow/ice occurs across the bergschrund system, (7) displacement across the bergschrund due to flow of the main glacier body results in significantly more snow being deposited each winter down-glacier of the bergschrund than up-glacier of it. (Author's abstract)
W84-02686

RAINFALL INTENSITY-DURATION-FREQUENCY FORMULAS,
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
C.-L. Chen.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1603-1621, December, 1983. 3 Fig, 7 Tab, 16 Ref.

Descriptors: *Rainfall intensity, *Rainfall duration, *Rainfall frequency, Return period, Spatial distribution, Mathematical models.

A new general rainfall intensity-duration-frequency formula is presented, utilizing a method similar to, but more accurate than one previously developed. The depth-duration ratio, though likely to be independent of return period, varies approximately from 10%-60% with the geographical location. The depth-frequency ratio, though likely to be independent of duration, varies approximately in the range of 1.33-1.63 with geographical location. The previously developed formula was based on the average depth-duration ratio of about 40% and the mean depth-frequency ratio of 1.48. This formula requires only the 10-yr 1-hr rainfall depth instead of the three rainfall depths (i.e., 10-yr 1-hr, 10-yr 24-hr, and 100-yr 1-hr). This value alone cannot measure the geographic variations of rainfall. The ratios of 1-hr to corresponding 24-hr depth and 100-yr to corresponding 10-yr depth can be computed from the required three rainfall depths in the present method so that geographical variation of rainfall can be evaluated in terms of both ratios. The general formula outperforms the previously developed formula in accuracy, regardless of whether values are within or outside the range of applicability of the previously developed formula. (Moore-IVI)
W84-02875

ASPECTS OF RAINFALL EXCESS FROM SPATIALLY VARYING HYDROLOGICAL PARAMETERS,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Mathematics and Statistics.
R. A. Maller, and M. L. Sharma.
Journal of Hydrology, Vol. 67, No. 1-4, p 115-127, 1984. 3 Fig, 16 Ref.

Descriptors: *Excessive precipitation, *Spacial distribution, *Parametric hydrology, Rainfall, Ponding, Mathematical studies, Phillip's two-parameter equation, Infiltration.

The present rainfall excess measurement methods is subject to limitations of computer space and high costs. Rainfall excess for a given rain intensity can be calculated though from the extended form of Philip's two-parameter equation. This equation is assumed to hold after a time when the water has started to pond on the soil surface. A direct mathematical procedure is developed by which the distribution of areal cumulative infiltration can be calculated from the distributions of S and Ks. This enables detailed analysis of effects of joint variability of S and Ks on the expectation and standard deviation of areal rainfall excess. The effect of variability in the estimation of the mean parameter in the log-normal distribution of S on the distribution of tp can assess the distribution of tp to within a given accuracy for the number of samples required. The expected value of tp cannot be investigated in this way, since it may be infinite, even in the set of sample points where ponding does eventually occur. (Murphy-IVI)
W84-02889

2C. Snow, Ice, and Frost

THE IMPORTANCE OF PRESSURIZED SUBGLACIAL WATER IN SEPARATION AND SLIDING AT THE GLACIER BED,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. Bindschadler.
Journal of Glaciology, Vol. 29, No. 101, p 3-19, 1983. 5 Fig, 1 Tab, 32 Ref.

Descriptors: *Glaciers, *Glacier surges, *Sliding, Subglacial water, Water pressure, Bed separation index, Basal shear stress, Variegated Glacier, Ice Stream B, Antarctica, Columbia Glacier, Alaska.

Many glaciers slide over their beds. Surging glaciers are examples of situations in which sliding dominates the ice motion, but many normal glaciers also exhibit appreciable sliding motion. The effect of pressurized subglacial water on the sliding process is examined by a parameter called the 'bed separation index'. This index indicates the relative extent of cavity formation by combining the effects of variation of bed-normal stress across undulations and steady-state water pressure in a Rothlisberger

conduit at the glacier bed. Data from three glaciers of widely varying size are used to test the correlation of the bed separation index with inferred sliding rates. For Columbia Glacier (Alaska) and Ice Stream B in West Antarctica, high water pressure enhances sliding. More complete data from the third test case, Variegated Glacier, are used to compare a number of possible formulations of a 'sliding law'. Over time scale less than years, the spatial and temporal variations of water pressure play the active role, and basal sheer stress the passive role in basal sliding. It then becomes obvious that water pressure is one of the most fundamental parameters of the sliding process. Consideration of the transverse variation of water pressure and bed separation index indicates that, in the main conduit, only a rise of water presure above a critical level should cause a substantial increase in the separation across the glacier. The duration of the increased sliding would last only as long as it took for the glacier hydraulics to adjust. This is consistent with the observations made on Variegated Glacier where both the basal stress and the average summer sliding velocity increased annually through the latter half of the quiescent phase, before the surge occurred. (Moore-IVI)
W84-02684

BASAL WATER FILM, BASAL WATER PRESSURE, AND VELOCITY OF TRAVELING WAVES ON GLACIERS,
Northwestern Univ., Evanston, IL. Dept. of Materials Science.
J. Weertman, and G. E. Birchfield.
Journal of Glaciology, Vol. 29, No. 101, p 20-27, 1983. 2 Fig, 6 Ref. NSF grants ATM-78/3961 and ATM-81/1138.

Descriptors: *Glaciers, *Glacier surges, *Water pressure, *Traveling waves, Basal water pressure, Sliding.

Because of seasonal melt-water fluctuations, temperate glaciers usually have large seasonal fluctuations in their motion although the basal shear stress remains almost unchanged during a period of one year. The theory of traveling waves on glaciers is extended to cover the situation where the presence of abundant basal water or increased basal water pressure produces increased sliding of a glacier over its bed. The ratio of traveling-wave velocity to surface velocity is independent of the amount of water or the basal water pressure. The theoretical value of this ratio, about 4 to 5, agrees with that found in field measurements (the most recent data are from Mer de Glace). Field observations of traveling-wave velocities lend strong support to any glacier sliding theory in which the sliding velocity is proportional to the basal shear stress raised to about a second to fifth power and in which the sliding velocity is a function of either or both the amount of water at the bed of a glacier and the pressure within this water. The traveling-wave observations are almost inexplicable to any theory in which the sliding velocity does not have this dependence on basal shear stress. (Moore-IVI)
W84-02685

MODIFICATIONS TO THE THEORY OF INTRAGLACIAL WATERWAYS FOR THE CASE OF SUBGLACIAL ONES,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
L. Lliboutry.
Journal of Glaciology, Vol. 29, No. 102, p 216-226, 1983. 1 Fig, 18 Ref.

Descriptors: *Glaciers, *Subglacial waterways, *Glaciohydrology, Plastic deformation, Ice, Groundwater, Heat, Sliding.

It is argued that in temperature mountain glaciers, waterways are subglacial. It is shown that the theory of Spring and Hutter (1981, Cold Regions Science and Technology 4(3):227-244) for intraglacial flooded conduits leads to an equation for the grade line which differs from Rothlisberger's (1972, J. of Glaciology 11(62):177-203) only by negligible terms, and a slight modification of the exponent of the discharge. For a subglacial flooded waterway two important processes should instead be introduced: the enhancement of plastic deformation on the up-stream side of bumps, and the heat afforded by ground water (which in winter accounts for most of the discharge). The theory modified in this way explains why Rothlisberger had to adopt an unrealistic value for the rheological parameter of ice. It leads to the conclusion that in areas which are not overdeepened, most of the year subglacial waterways should remain not flooded and at atmospheric pressure. The case of overdeepening is examined. Finally the implications of this new model for glacier sliding theory are demonstrated. (Author's abstract)
W84-02687

WATERWAYS, ICE PERMEABILITY AT DEPTH, AND WATER PRESSURES AT GLACIER D'ARGENTIERE, FRENCH ALPS,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
D. Hantz, and L. Lliboutry.
Journal of Glaciology, Vol. 29, No. 102, p 227-239, 1983. 8 Fig, 20 Ref.

Descriptors: *Glacier d'Argentiere, *France, *Ice permeability, *Glaciohydrology, *Water pressure, Pore pressure, Air temperature, Meltwater, Glacial streams.

To clear up the changes which had happened at the subglacial catchment of glacier d'Argentiere, an extensive study, with 31 borings and a coring down to the bottom (240 m) was performed in 1979/80, just upstream from the catchment, in an overdeepened area. The behavior of the water level during boring with a hot water jet, and just after, was different from one bore hole to another, mainly because transient leaks appeared in the walls of bore holes. Next, the water level fluctuated slowly, in the same way in most of the deep bore holes, showing that glacier ice below about 100 m deep is slightly pervious. What is so measured is the pore pressure of water in deep ice. The piezometric gradient between bore holes, and the time lag between fluctuations of water level, which increases with distance from the right bank, shows that there is no waterway at the bottom of the overdeepened area, save at its up-stream end. Most of the melt water must flow between ice and rock along the right bank, its free surface rising by about 150 m during the increased discharge in June. No clear-cut correlation between the bottom pore pressure and the air temperature or the discharge at the subglacial catchment down-stream was found. (Author's abstract)
W84-02688

SPECTRAL REFLECTANCES OF SNOW AND FRESH-WATER ICE FROM 340 THROUGH 1,100 NM,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Bolsenga.
Journal of Glaciology, Vol. 29, No. 102, p 296-305, 1983. 5 Fig, 25 Ref.

Descriptors: *Spectral reflectance, *Remote sensing, *Snow, *Ice, Slush, Brash, Ice cover, Reflectance.

Measured spectral reflectances of new and moderately metamorphosed snow were generally >80% from 340-950 nm. From 950-1,100 nm a characteristic dip and rise of spectral reflectances occurred. One spectroradiometer scan over a deteriorated snow patch showed much lower spectral reflectances than fresh snow, but the shape of the curve remained similar to that of fresher snow. Spectral reflectances for clear ice contrasted sharply with those for snow. In general, values were <10% and the curves lacked distinctive shape. Higher spectral reflectances, due to 'lighter'-appearing ice in the measurement area, were measured at some sites. Refrozen slush, pancake, brash, and slush curd ice revealed spectral reflectance curves similar in form to each other, but which varied significantly in the range of spectral reflectances for each ice type. Generally, reflectances rose slowly from 340 nm to a peak near 550 nm. From 550-775 nm reflectances decreased slowly but significantly. A slight dip and rise in reflectances occurred from 775-850 nm after which values again dipped significantly (850-900 nm). From 950-1,100 nm, a dip and rise in reflectances similar to that for snow was observed. The amount of slush included seems to control the reflectances of these ice types. All measurements were acquired with a pair of scanning spectroradiometers having picowatt accuracy, adapted to obtain, automatically, simultaneous readings of incident and reflected radiation from 340-1,100 nm. The spectroradiometers were field-calibrated using Sun-plus-sky radiation as a calibration source. (Author's abstract)
W84-02689

AREAL VALUE OF DEGREE-DAY FACTOR,
Kwara State Coll. of Technology, Ilorin (Nigeria). Dept. of Survey.
A. K. Bagchi.
Hydrological Sciences Journal, Vol. 28, No. 4, December, 1983. 8 Fig, 3 Tab, 6 Ref.

Descriptors: *Snowmelt, *Degree-days, *Runoff, Himalayas, Beas Basin, Streamflow, Snow cover, Model studies, Mathematical models.

A method of determination of areal value of degree-day factor by plotting basic snowmelt, against the degree-day multiplied by the area of the snow cover is presented. Beas basin above Manali situated in the western Himalayas was chosen as the experimental basin. The question of open patches in the snow cover poses difficult problems in conceptual modelling of snowmelt runoff. Some ignore it, others measure snow cover patch by patch by satellite images. It may be necessary to use a variable degree-day factor in a patched snow area. If the entire area above the transient snow line is taken as snow covered, then a constant value of degree-day factor should be used. (Murphy-IVI)
W84-02828

WATER MOVEMENT INTO SEASONALLY FROZEN SOILS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 2G.
W84-02856

MONITORING THE UNFROZEN WATER CONTENT OF SOIL AND SNOW USING TIME DOMAIN REFLECTOMETRY,
Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 2G.
W84-02862

RIVER ICE JAMS: THEORY, CASE STUDIES, AND APPLICATIONS,
National Water Research Inst., Burlington (Ontario).
S. Beltaos.
Journal of Hydraulic Engineering, Vol. 109, No. 10, p 1338-1359, October, 1983. 11 Fig, 2 Tab, 22 Ref.

Descriptors: *Ice jams, *Water level, *Hydraulic resistance, Hydraulic roughness, Shear stress, River flow.

The existing theory of floating ice jams in rivers was examined in the light of field data accumulated in recent years. The theory developed gradually since the late 1950's and predicts the jam thickness so that the jam, considered a granular mass, can withstand the applied forces. These forces are caused by the flow shear stress and by the streamwise component of the jam's own weight. Two types of jams have been identified: 'wide' and 'narrow' channel jams. The former type should be far more common in nature since the latter type can only exist at very small aspect ratios. The theory was tested with satisfactory outcome with available field data. Because the thickness of spring jams cannot be measured at present, the data do not permit direct estimates of the applicable roughness and internal friction characteristics. A method for arriving at such estimates indirectly, based on existing hydraulic resistance data for winter jams

of which the thickness can be measured once freezing in place has occurred to allow safe access, was applied to 13 case studies. Two methods of applying the results were outlined: a detailed method that makes use of the ice jam theory in conjunction with hydraulic resistance considerations; and a simplified method that uses the average eta versus xi relationship as defined by the data. Examples indicate that the detailed method gives better results that the simplified method. The major limitations of applying the theory to practical questions derive from the assumption of an equilibrium jam affecting fully the site of interest. This may not be the case in any given year; thus the theory can only provide an upper bound of anticipated water level as a function of discharge. (Moore-IVI)
W84-02868

ASYMMETRIC PLANE FLOW WITH APPLICATION TO ICE JAMS,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 8B.
W84-02872

2D. Evaporation and Transpiration

CARBOHYDRATE PARTITIONING IN RELATION TO WHOLE PLANT PRODUCTION AND WATER USE OF VIGNA UNGUICULATA (L.) WALP.,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
For primary bibliographic entry see Field 2I.
W84-02489

THE EFFECT OF DOUBLING ATMOSPHERIC CO2 ON STREAMFLOW: A SIMULATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
A. R. Aston.
Journal of Hydrology, Vol. 67, No. 1-4, p 273-280, 1984. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Atmospheric carbon dioxide, *Streamflow, Computer models, Vegetation, Carbon dioxide, Air pollution effects, Agricultural hydrology, Plant water potential, Stomata, Stomatal transpiration.

There is a potential for atmospheric CO2 to rise four- or six-fold, and at some time in the forseeable future a doubling of stomatal resistance seems, on present evidence, to be inevitable. A distributed deterministic process model simulates the effects of changed stomatal resistance on streamflow of a 5 ha experimental catchment and a large (417 sq km) water-supply area. It can be expected that streamflow will increase from 40 to 90% as a consequence of doubling of atmospheric CO2 concentration. (Murphy-IVI)
W84-02898

SOIL SURFACE EVAPORATION AND WATER TABLE DEPTHS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 366-376, December, 1983. 4 Fig, 3 Tab, 14 Ref. SFWMD grant 4-FCD-22.

Descriptors: *Soil surfaces, *Evaporation, *Water table, Evapotranspiration, Pan evaporation, Model studies, Water level.

The knowledge of the amount and rate of evapotranspiration is useful not only for irrigation studies but also for the development of hydrological models. The experiment was conducted in lysimeters for studying the evaporation from soil surface in relation to water table depth and standard pan evaporation. Dummy variables 1 and 0 were used as an alternative to analyze the variation and covariance to compare the soil surface evaporation difference between water table depths. The dummy variable regression analysis can simultaneously test the difference between two regression lines whether due to slope coefficients or intercept terms. The water table depth was significantly affected on the soil surface evaporation. The soil surface evaporation for 38 cm water table was significantly smaller in value than that for the 8 cm water table. The soil surface evaporation in wet season had a smaller deviation from the standard pan evaporation and had a more homogeneous distribution within the wet season than that in the dry season. (Murphy-IVI)
W84-02925

2E. Streamflow and Runoff

NORTHERN OMAN FLOOD STUDY,
Imperial Coll. of Science and Technology, London (England).
H. S. Wheater, and N. C. Bell.
Proceedings of the Institution of Civil Engineers, Vol. 75, Part 2, p 453-473, September, 1983. 11 Fig, 5 Tab, 27 Ref.

Descriptors: *Floods, *Flood frequency, *Oman, Frequency analysis, Mathematical studies, Probability distribution, Model studies, Wadi Adai, Muscat, Rainfall-runoff relationships.

A depth-duration-frequency relationship for short duration rainfall in Northern Oman was developed, based on the station-year method. The relationship is generally consistent with the frequency distribution of daily rainfall as determined from the Muscat record and with published work from a similar rainfall regime in Saudi Arabia. Analysis of flood data from the Wadi Adai gives the frequency of the storm of 3 May 1981 as between 100-300 years return period, corresponding to a peak discharge of 1160 cu m/s. Observations of the 3 May flood in the Wadi Adai were fully reproduced using a kinematic wave model based on catchment slopes and roughness for an initial loss of 8 mm and continuing runoff proportion of 0.75 for hard rock and 0.50 for gravel hill areas. Sensitivity analysis has indicated that while the overall runoff coefficient is primarily dependent on the estimated total rainfall, the distribution of losses cannot be uniquely confirmed. (Baker-IVI)
W84-02509

CAPACITY OF RIVER CHANNELS WITH FLOODPLAINS,
N. B. Baryshnikov, and E. S. Subbotina.
Hydrotechnical Construction, Vol. 17, No. 6, p 302-306, June, 1983. 3 Fig, 1 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 18-21, June, 1983.

Descriptors: *Channels, *Capacity, *Flood plains, Rivers, Streamflow, River flow, Boussinesq coefficient, Coriolis coefficient, Coriolis force.

Investigations of the problem of the interaction of channel and floodplain flows revealed a substantial transformation of the velocity fields of the channel flow under the effect of the floodplain flow and of the floodplain flow under the effect of the channel flow. Therefore, to apply equations of hydraulics to a calculation of the capacity of channels with floodplains it is necessary to estimate the influence of the kinematic effect on these coefficients. In natural and artificial flows the Boussinesq and Coriolis coefficients vary in wide limits. The morphological characteristics of the river channels, the presence of midstream bars, vegetation, and the flow regime of the stream have a great effect on their values. Considerable changes in the Boussinesq and Coriolis coefficients in the channel part of the flow occur under the effect of the interaction of channel and floodplain flows. When using mean velocities instead of local velocities in calculations it is impermissible to neglect the values of the Boussinesq and Coriolis coefficients, which according to the data reported reach respectively 2-3 and 4-6. (Baker-IVI)
W84-02663

MEASURING WATER SURFACE AND STREAMBED ELEVATION CHANGES WITH THE ACOUSTIC VELOCITY METERING SYSTEM,
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen.
Water Resources Research, Vol. 19, No. 5, p 1317-1322, October, 1983. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Water surface elevation, *Measuring instruments, *Acoustic velocity metering, Water depth, Streambeds, Sacramento River, California, Cowlitz River, Oregon.

Acoustic velocity metering (AVM) systems used to measure the water velocity along a diagonal path across a stream can also be used to measure stage and streambed changes. Underwater acoustic transmissions reflected from the water surface can accurately measure depth above transducers. Similarly, signals reflected from the streambed can indicate streambed changes in the vicinity midway between transducers. Surface reflected signals detected at the Sacramento River near Freeport, California, were used to calculate a water surface elevation that agreed with the observed to within 0.2%. Reflected signals from the surface have been detected at many AVM sites; however, surface conditions are not always favorable for measuring these occurrences. From May 11 to June 4, 1982, streambed elevations in the Cowlitz River at Castle Rock, Washington decreased an average of 0.6 m. Dune peaks decreased 0.7 m for this same period, while troughs decreased 1.0 m. Interpretation of oscilloscope photographs of the received pulses from the AVM equipment indicate that dune peaks decreased 0.8 m. (Baker-IVI)
W84-02771

AREAL VALUE OF DEGREE-DAY FACTOR,
Kwara State Coll. of Technology, Ilorin (Nigeria). Dept. of Survey.
For primary bibliographic entry see Field 2C.
W84-02828

SEVERAL METHODS FOR DISCHARGE MEASUREMENTS OF FLOODS,
Faculty of Civil Engineering Sciences, Split (Yugoslavia).
O. Bonacci.
Hydrological Sciences Journal, Vol. 28, No. 4, p 513-524, December, 1983. 4 Fig, 1 Tab, 15 Ref, 1 Append.

Descriptors: *Flood discharge, *Flood hydrographs, *Integrated method, Rising float method, Flow discharge, Floods.

Flow discharge measurements during floods are of considerable importance, but particularly difficult to obtain. In addition, such measurements are very expensive and often the lives of the people carrying them out are endangered. Three methods of discharge measurement during floods are described: the integrated method; discharge measurements of the total flood hydrograph; and rising float methods. Each method is suitable for a particular type of river, and the choice of method is left to the people engaged in measurements. Hydrological practice (especially in developing countries) shows that there is a significant lack of information on discharge in flood periods, and it is known that even very complex methods and precise equipment very often prove inadequate. Therefore, relatively simple measurement methods using standard equipment which make it possible to shorten the period of metering and to make contact with the river as brief as possible, are recommended. The rising float technique entirely eliminates contact between the staff and the water, and this seems to be one of the advantages governing its application in the future. (Moore-IVI)
W84-02829

THE YANGTZE RIVER; PAST, PRESENT, AND FUTURE,
Woods Hole Oceanographic Institution, MA. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2L.
W84-02831

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 1. ANALYSES AND CONCEPTS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W84-02846

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 2. THEORY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W84-02847

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 3. CASE STUDIES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W84-02848

A BAYESIAN MARKOV MODEL OF THE FLOOD FORECAST PROCESS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. Krzysztofowicz.
Water Resources Research, Vol. 19, No. 6, p 1455-1465, December, 1983. 10 Fig, 1 Tab, 22 Ref. NWS contract 6-35229, NSF grant CEE-8107204.

Descriptors: *Flood forecasting, *Mathematical models, Markov chain, Stochastic process, Flood hydrographs, Decision making.

One of the components of a model of the flood forecast-response process is a stochastic law Phi governing the state transitions of the flood forecast process. The law Phi describes joint uncertainty about the actual realization of the flood stage hydrograph and about the accuracy of a sequence of categorical forecasts of the flood crest. The flood forecast process is conceptualized as a discrete time, finite, random duration, bivarite Markov chain. The modeling has been accomplished via a Bayesian approach. It is the optimal approach to decision making based on real time forecasts because it allows one to explicitly account for forecast uncertainty; that is, an optimal decision should always be made against the posterior distribution of the state given the forecast of that state. It allows one to exploit all the relevant data records which typically are much longer for the flood process than for the forecast process. It lends itself ideally to dynamic programming computations (typically performed while solving Markovian decision problems) in that at any decision stage the posterior transition probabilities can be computed by applying Bayes theorem recursively, in parallel with the dynamic programming algorithm. It enhances the implementability of the model for it offers approximations to bivariate transition probability functions which require the estimation of only univariate functions. The structure of the model is motivated by an analysis of historical flood forecast records. The model is intended primarily as a component of a decision methodology for determining the economic value of and the optimal decisions in response to riverine flood forecasts. (Moore-IVI)
W84-02849

CATEGORY-UNIT LOSS FUNCTIONS FOR FLOOD FORECAST-RESPONSE SYSTEM EVALUATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6B.
W84-02850

MIXED-STATION EXTENSION OF MONTHLY STREAMFLOW RECORDS,
Geological Survey, Reston, VA.
W. M. Alley, and A. W. Burns.
Journal of Hydraulic Engineering, Vol. 109, No. 10, p 1272-1284, October, 1983. 4 Fig, 2 Tab, 8 Ref, 2 Append.

Descriptors: *Streamflow records, *Interstation correlation, Multiple regression analysis, Streamflow, Mathematical studies.

Monthly streamflow records at a site are sometimes extended by exploiting interstation correlation of streamflow, often through simple linear regression with a base station having a long-term record. An approach is presented which selects a base station from among several in a region for filling in missing data. It differs from traditional approaches in that different stations can be selected as the base station to fill in different values. The approach also provides a decision rule for using only flow values from the same month or all flow values in developing the extension equation used for estimating a particular missing value. A previously presented extension equation to minimize variance bias of the flows estimated at the short-record station is shown to be applicable to this technique. The possibility of using this extension equations to adjust the results of multiple regression in order to account for variance reduction is also suggested. (Author's abstract)
W84-02864

UNIFIED THEORY FOR FLOOD AND POLLUTION ROUTING,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W84-02878

ON THE NUMERICAL SOLUTION OF THE SAINT-VENANT EQUATIONS,
Warsaw Univ. (Poland). Faculty of Geography and Regional Studies.
I. Stepien.
Journal of Hydrology, Vol. 67, No. 1-4, p 1-11, 1984. 7 Fig, 7 Ref.

Descriptors: *Power plants, *Unsteady flow, Poland, Vistula River, Saint-Venant equations, River flow, Flow discharge.

Unsteady flow below the hydropower station on the Vistula River in Poland was investigated. The implicit four-point method was used for solving the Saint-Venant equations. A 60 km reach of river with a bottom slope of 0.0002 was investigated. A diagram of the river segment and location of the control depth gauges is given. The observed range of variability of the water level did not exceed 200 cm and the corresponding variations of discharge were contained within the interval of 500-2000 cu m/sec. For such values of levels and flow rates, discharge does not exceed the values for bankfull flow and the rectangular shape of the bed may be assumed with mean width of 370 m calculated from hydrometric records for the examined river segment. Results of the numerical experiments were compared successfully with the recorded series of flow at several control depth gauges on a 60 km long branch of the Vistula River. (Baker-IVI)
W84-02882

IDENTIFICATION OF THE INPUT-OUTPUT STOCHASTIC MODEL WITH CORRELATED ERRORS,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
W. G. Strupczewski, and R. J. Budzianowski.
Journal of Hydrology, Vol. 67, No. 1-4, p 13-23, 1984. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Hydrologic models, *Flow, *Stochastic process, *Input-output analysis, Mathematical models, Prediction, Rainfall-runoff relationships, River flow.

A stochastic discrete system approach to flow prediction is presented. The structure of the deterministic part of the model is of the ARMA type as a result of formal discretization of the continuous differential equation. The orders of the AR and MA parts are equal. The random residuals of the model are correlated and have to be modeled by a separate time series model. A model of the stochastic part is built up by means by Kalman's theorem. The maximum likelihood estimation method is applied, which results in a nonlinear optimization problem. Then the Lagrange multipler method for gradient determination and Wolfe's variable metric gradient method for this optimization are used. The model assumes a linear relation between input and output variables. The inflow-outflow relation can be treated approximately as a linear one. The stochastic part can allow in part for modelling errors. In the case of rainfall-runoff modelling or water level prediction, a stronger nonlinearity could be involved and the investigated model would fail. The developed algorithm has been applied to flow forecasting at a 30-km river reach. (Moore-IVI)
W84-02883

ENVELOPE CURVES FOR EXTREME FLOOD EVENTS IN NORTHWESTERN AND WESTERN GREECE,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
Journal of Hydrology, Vol. 67, No. 1-4, p 55-66, 1984. 3 Fig, 2 Tab, 7 Ref.

Descriptors: *Greece, *Flood peak, Drainage basins, Climate, Depth-area-duration analysis, Flood flow, Storms.

Maximum flood experience in the northwestern and western regions of Greece can be depicted in graphs on which the maximum observed peak discharges are plotted against drainage areas. The peak discharges are found to be power functions of the drainage areas, and the curves enveloping the plotted points differ from region to region according to the climatic regime. The exponents of the Greek envelope curves are in the range of values of the exponents of yearly floodflow-drainage area envelope curves developed in conterminous U.S. basins, but the former curves' constants are much lower than the latter. When the peak discharges are plotted against a morphoclimatic index, which is the product of the expected storm duration by the maximum observed average storm intensity for this duration by the area of the drainage basin, a single linear envelope curve is drawn for both regions that explains 95% of the regional variation in the dependent variable. This curve is free from several drawbacks of floodflow-drainage area envelope curves, i.e. it does not need the determination of region boundaries, etc. The developed envelope curves can predict peak discharges at certain probability levels for ungauged basins of the area and can be used in specific engineering applications. (Author's abstract)
W84-02885

FITTING THE SB CURVE BY THE METHOD OF MAXIMUM LIKELIHOOD,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and T. Jivajirajah.
Journal of Hydrology, Vol. 67, No. 1-4, p 67-75, 1984. 4 Tab, 8 Ref, 1 Append.

Descriptors: *Rainfall, *Streamflow, *Maximum likelihood, Method of moments, Statistical methods, Jacobean matrix, Hydrologic data, Portugal.

Newton's method was used to solve the system of nonlinear equations of which the solution are the maximum likelihood estimates of the four parameters of the S sub B curve. All elements of the related Jacobian matrix were explicitly given and suitable sums needed in the computation were introduced. A comparison was made between the methods of moments and maximum likelihood using 20 sets of annual streamflows, and 15 sets of annual rainfall data from Portugal. For annual streamflows, there were 19 cases where the method of moments was applicable. The method of maximum likelihood was applicable in only 13 out of 20 cases. Thus the method of moments is most applicable for annual streamflow data. It is also more applicable to annual rainfall data than the method of maximum likelihood. For the S sub B distribution, expressions for computing its moments are not available in closed form. When the method of maximum likelihood is used to estimate

its parameters, the useful statistical descriptions cannot be readily computed. Numerical schemes should be used and this may make the maximum likelihood method less attractive than the method of moments. (Moore-IVI)
W84-02886

ESTIMATION OF STORMFLOW VOLUMES FROM SMALL SEMI-ARID CATCHMENTS USING THE R-INDEX METHOD,
Zululand Univ., Empangeni (South Africa). Hydrological Research Unit.
A. S. Hope.
Journal of Hydrology, Vol. 67, No. 1-4, p 129-139, 1984. 1 Fig, 5 Tab, 10 Ref.

Descriptors: *Storm runoff, *Semiarid climates, *Watersheds, *R-index method, Runoff volume, Runoff rates, Cumulative runoff, Rainfall-runofff relationships, Model studies, Model testing.

The R-index method for calculating stormflow volumes was intended for use on forested and wildland catchments in the eastern U.S.A. This study calibrates the R-index model on stormflow data from three semi-arid catchments in South Africa and evaluates the performance of the method under these conditions. The R-index method is suitable for stormflow estimates in these semi-arid catchments. Parameter values for the model differ markedly to those in humid and subhumid catchments and the effect of antecedent moisture conditions on stormflow volumes is generally unimportant particularly for the larger events. The satisfactory results obtained from diverse environmental regions suggests that the model components account for the major variables affecting stormflow production. (Murphy-IVI)
W84-02890

WATERSHED MORPHOMETRY AND TIME TO HYDROGRAPH PEAK,
North Texas State Univ., Denton. Dept. of Geography.
J. M. Harlin.
Journal of Hydrology, Vol. 67, No. 1-4, p 141-154, 1984. 5 Fig, 1 Tab, 30 Ref.

Descriptors: *Watersheds, *Morphology, *Hydrographs, *Peaking capacity, Peak loads, Hypsometric analysis, Hydrograph analysis, Rainfall-runoff relationships.

Morphometric complexities often render geomorphic parameters ineffective in maintaining stable relationships over space with various aspects of hydrograph shape. Drainage density, for example, may relate either directly, or indirectly, with time-to-hydrograph peak depending upon environmental characteristics. Variations in climate, geology and degree of geomorphic development in large measure stimulate morphometric complexities. The hypsometric curve (an expression of overall basin slope) should be combined with basin area and/or relief to promote transferable hydrologic models. Three aspects of hypsometric curve form are compared to time-to-peak following intense storms in small agricultural experimental watersheds in West Virginia, Oklahoma and Vermont. A significant multiple regression-correlation relationship is forthcoming between time-to-peak and hypsometric form with no direct control for basin area, relief, relief ratio, or drainage density. Hypsometric skewness is related to headward drainage development, mid-basin slope is assessed through hypsometric density kurtosis, and the rate of change in upper and lower basin slope is quantified by hypsometric density skewness. Hypsometry should not preclude the use of other important watershed parameters, like drainage area, but hypsometric techniques might be employed along with basin area and/or relief to increase the predictive power and transferability of rainfall-runoff models. (Murphy-IVI)
W84-02891

THE EFFECT OF DOUBLING ATMOSPHERIC CO2 ON STREAMFLOW: A SIMULATION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2D.
W84-02898

EVALUATION OF FIELD DRAINAGE DISCHARGE FROM HEAVY LAND IN THE TROPICS,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
L. K. Smedema.
Journal of Hydrology, Vol. 67, No. 1-4, p 325-337, 1984. 5 Fig, 2 Tab, 4 Ref.

Descriptors: *Drainage, *Discharge measurement, *Heavy land, *Tropical regions, Discharge hydrographs, Soil water potential, Soil properties, Runoff volume, Surface runoff, Runoff forecasting.

Much tropical land is classified as heavy land, having a profile composed of a shallow, well-structured and well-permeable top layer of approximately 30-40 cm depth, overlying a poorly permeable subsoil. In a Tanzanian sugarcane field the drainage consisted of an in-field system of shallow ditches intercepting drainage flow in the cane furrows (row drainage). The discharge predictions of three relevant rainfall-discharge models, i.e. a linear storage model, a travelling time model (rational formula) and the curve number/synthetic unit hydrograph model of the U.S. Soil Conservation Service when compared with observed hydrographs produce good agreements with the linear storage model although, in this case, the linearity between discharge rate (q) and dynamic storage (S) appeared to be somewhat incidental, being promoted by the particular row drainage layout of the field. (Murphy-IVI)
W84-02901

BRASS MODEL: PRACTICAL ASPECTS,
Army Engineer District, Savannah, GA.
For primary bibliographic entry see Field 7B.
W84-02921

COMPUTATIONAL MODEL FOR THE OHIO RIVER CHUTES AT LOUISVILLE: THE 1972 VIRGIN CONDITIONS,
For primary bibliographic entry see Field 7C.
W84-02932

2F. Groundwater

PATTERNS IN GROUNDWATER QUALITY: SELECTED OBSERVATIONS IN IOWA,
Iowa Univ., Iowa City. Dept. of Geology.
For primary bibliographic entry see Field 5G.
W84-02644

THE INTERACTION OF LAKES WITH VARIABLY SATURATED POROUS MEDIA,
Geological Survey, Denver, CO.
T. C. Winter.
Water Resources Research, Vol. 19, No. 5, p 1203-1218, October, 1983. 9 Fig, 38 Ref.

Descriptors: *Groundwater movement, *Lakes, *Porous media, *Saturation, Groundwater recharge, Seepage, Surface water, Infiltration, Simulation, Aeration zone.

Numerical simulation of variably saturated porous media indicates that groundwater recharge is variable in time and space, depending on the thickness of the unsaturated zone through which infiltrating water must move. The resulting complex, transient groundwater flow systems have significant impact on contiguous surface water. In very permeable media, small, local, closed groundwater flow systems can develop and dissipate within a few weeks to several months after major recharge. These have a direct effect on contiguous surface water by alternately causing seepage to and seepage from the surface water. The transient nature of these flow systems indicates that reversals of the direction of groundwater flow may be common. In less permeable media the same complex flow systems may occur, but the time for development and dissipation is much greater. For example, it is conceivable that small, local flow systems may exist for many months or years as a result of major recharge. Therefore directions of flow in such systems are more stable, and the effect on contiguous surface water also is more stable. The findings of this study indicate that wells and groundwater quality sampling sites need to be carefully located to define accurately water table configuration, groundwater recharge, direction of seepage through the beds of surface water bodies, and complex geochemical processes related to changing directions of groundwater flow. (Author's abstract)
W84-02764

SOME NEW PROCEDURES FOR NUMERICAL SOLUTION OF VARIABLY SATURATED FLOW PROBLEMS,
Geological Survey, Denver, CO.
R. L. Cooley.
Water Resources Research, Vol. 19, No. 5, p 1271-1285, October, 1983. 12 Fig, 27 Ref, 1 Append.

Descriptors: *Groundwater movement, *Saturated flow, *Unsaturated flow, *Mathematical models, Computer models, Seepage surfaces.

Persistent difficulties that arise in forming numerical solutions of variably saturated flow problems include controlling the stability of the nonlinear equation solvers and devising a reliable, yet efficient, method for determining the positions of seepage surfaces. New techniques for addressing these problems are applied to a subdomain finite element discretization of the governing flow equations. The subdomain finite element method used produces accurate results, and has an added advantage over finite difference methods of accomplishing a greater amount of nodal averaging of troublesome nonlinear quantities to improve stability. New procedures for solving the nonlinear matrix equation that results from the finite element method and for locating the positions of seepage faces are capable of solving a wide variety of variable saturated flow problems. (Moore-IVI)
W84-02768

SUBSURFACE ORGANIC CONTAMINANTS,
For primary bibliographic entry see Field 5B.
W84-02792

MAJOR ION CHARACTERIZATION OF COASTAL SALINE GROUND WATERS,
Toronto Univ. (Ontario). Dept. of Geology.
K. W. F. Howard, and J. W. Lloyd.
Ground Water, Vol. 21, No. 4, p 429-437, July-August, 1983. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Groundwater movement, *Saline water, *Coastal aquifers, *Ions, England, Lincolnshire, Humberside, Dilution diagrams, Saline water intrusion, Mixing.

Attempts to classify saline groundwaters in coastal aquifers using established trilinear diagram techniques are frequently inconclusive due largely to the dominance of sodium and chloride ions. In a study of saline ground waters from the Chalk limestone of Lincolnshire and Humberside in eastern central England, an alternative, less conventional, dilution diagram procedure is employed which reveals previously unrecognized differences in local major ion chemical character. Differences are interpreted in terms of the origins of the saline ground waters and their histories of mixing. Significantly, the interpretations reinforce and, in some cases, refine earlier interpretations based on notably less extensive minor ion and environmental isotope data. The saline ground waters are associated with at least three periods of saline intrusion during the past 120,000 years. Two of the groundwater types are shown to be old by virtue of their mixing relationships that cannot be reconciled fully in terms of local fresh groundwater end-points. A third, modern water type shows strong evidence of reverse ion exchange, which is consistent with modern saline groundwater invading parts of an

aquifer that had previously provided an outlet for calcium-rich waters. (Moore-IVI)
W84-02803

AQUIFER TESTS AND WELL FIELD PERFORMANCE, SCIOTO RIVER VALLEY OHIO: PART II,
S. E. Norris.
Groundwater, Vol. 21, No. 4, p 438-444, July-August, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Aquifer testing, *Test wells, Wells, Aquifers, Water supply management, Scioto River, Ohio, Rivers, Permeability coefficient, Hydrology.

The aquifer testing program as described has offered a unique opportunity to determine the hydrologic properties of an important sand and gravel aquifer at 11 closely spaced sites. Significant data were acquired on variation in hydraulic conductivity of the sand and gravel aquifer and characteristics of induced stream infiltration. It has also been possible to compare recommendations for well design, made on the basis of the aquifer testing, with results of operation of a major well field. The sand and gravel aquifer studied is south of the glacial boundary and is fairly homogeneous, due largely to the absence of till interbeds. Nevertheless, test drilling revealed extensive areas where the sediment were considered too poorly permeable to warrant hydraulic testing. At the sites tested, where the sediments seemed favorable for developing supply wells, the transmissivity and also the hydraulic conductivity, when averaged over the full saturated thickness, differed by 2.4 times. The stream infiltration rate differed by 2.8 times and the streambed leakage factor differed by 15 times between highest and lowest values. Neither the infiltration rate values, nor those of the streambed-leakage factor, when considered in toto, correlated sensibly with stream discharge. The poor correlation between the hydraulic conductivity of the streambed and stream discharge suggests that there may be little variation in streambed conductivity caused by streamflow changes over the range of discharges observed during the tests. (Baker-IVI)
W84-02804

FLOW PATTERN OF A KARST AQUIFER IN THE MOLAI AREA, GREECE,
Ministry of Agriculture, Athens (Greece). Directorate of Land Reclamation.
I. C. Ghikas, G. P. Kruseman, I. L. Leontiadis, and D. H. Wozab.
Ground Water, Vol. 21, No. 4, p 445-454, July-August, 1983. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Aquifers, *Flow pattern, Groundwater movement, Greece, Molai Plain, Karst, Karst hydrology, Carbonates, Gulf of Lakonia, Water quality, Tectonics.

Geological, hydrological, hydrochemical, isotope, and pumping test data of the karst aquifer in the Mesozoic Tripolitza carbonates of the Molai area were analyzed. Two flow systems were identified in the carbonates. The western system discharges through the shore and submarine at Glyfada into the Gulf of Lakonia. Its catchment, which has no exploitable reservoir, is connected to the springs by a narrow conduit related to a fracture zone in marbles that accompany the Molai fault. Along the northern frings of the Molae Plain is the eastern flow system which has a reservoir with acceptable pumping levels less than 120 m deep. The water quality of this system is variable. The system discharges into the Aegean Sea, probably through dispersed seepage flow. The unusual characteristics of the karst in the Molai area can be explained by the continuous tectonic activity which has prevented the completion of various stages of karst development. The Molai area possesses the general characteristics of the Mediterranean climate: mild, wet winters, and moderately hot, dry summers. Nearly all precipitation falls in the form of rain from October-March with a peak in January. The long-term average annual precipitation in the carbonate area is about 670 mm. The tectonic activity continually interrupted the sequence of the karst formation, but also caused an extremely dense fracturing. Thus infiltration was evenly spaced over the carbonate outcrops, and vertical pipes had only occasionally developed in places where concentrated infiltration occurred. Horizontal pipes and caves never had a chance to develop fully. (Baker-IVI)
W84-02805

GROUND-WATER FLOW MODEL DETERMINATIONS OF AREAL HYDROGEOLOGY AND GEOLOGY,
Wisconsin Univ.-Madison. Dept. of Geology and Geophysics.
D. F. E. Pennequin.
Ground Water, Vol. 21, No. 5, p 552-557, September-October, 1983. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Groundwater movement, *Model studies, Wisconsin, Lake Wingra, Permeability coefficient, Anisotrophy, Sediments, Aquifers, Hydrogeology, Mathematical models.

A two-dimensional model is presented which closely simulates groundwater flow in a specific cross section of an area near Lake Wingra, Wisconsin. The model allows determination of the important hydrogeologic parameters needed to calculate the groundwater budget for Lake Wingra, and demonstrates the importance of groundwater flow models as tools that can be used in conjunction with other calculations to help estimate the groundwater component of a lake's water budget. In addition to gaining hydrogeologic information, this study suggests that by using groundwater flow models, it is possible to reconstitute the general subsurface geology and the configuration of geologic contacts in a fairly simple geologic setting, provided that some information on the geology, reliable hydaulic head measurements for different depths into the aquifer system, and a general knowledge of the horizontal hydraulic conductivities are available. (Baker-IVI)
W84-02808

ANALYSIS OF FLOW TO A LARGE-DIAMETER WELL BY A DISCRETE KERNEL APPROACH,
Baroda Univ. (India). Dept. of Civil Engineering.
S. C. Patel, and G. C. Mishra.
Ground Water, Vol. 21, No. 5, p 573-576, September-October, 1983. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Groundwater movement, *Wells, Drawdown, Discrete kernel approach, Mathematical studies, Aquifer properties.

A discrete kernel approach has been used to analyze unsteady flow to a large-diameter well, taking well storage into consideration. Several assumptions to the solution were made: the well discharges at a constant rate; at any time the drawdown in the aquifer at the well face is equal to that in the well; and the time parameter is discrete so that within each time step, the abstraction rate of water derived from well storage and that from aquifer storage are separate constants. The drawdown at the well obtained by this approach compares favorably with the drawdown evaluated by Papadopulos and Cooper's solution (Water Resources Research, Vol. 3, No. 1, p 241-244, 1967). The discrete kernel approach is simple and does not involve large computations. However, it cannot be applied for a large diameter well in an unconfined aquifer for it is applicable only for a linear system and the coefficients of the method are evaluated, assuming a constant transmissivity of the aquifer. (Baker-IVI)
W84-02810

REGIONAL TRENDS IN TRANSMISSIVITY AND HYDRAULIC CONDUCTIVITY, LOWER CRETACEOUS SANDS, NORTH-CENTRAL TEXAS,
Texas Univ. at Austin.
G. L. Macpherson.
Ground Water, Vol. 21, No. 5, p 577-583, September-October, 1983. 14 Fig, 1 Tab, 11 Ref. DOE contract DE-AS07-79ID12057.

Descriptors: *Aquifer properties, *Permeability coefficient, *Transmissivity, Sandstone, Balcones-Ouachita, Texas, Woodbine aquifer, Paluxy aquifer, Hosston/Trinity aquifer, Pumping tests.

Regional trends in aquifer properties can be deduced from a combination of pumping-test and performance-test data. Histograms show that the range and frequency distribution of estimated transmissivities in the Hosston/Trinity, the aquifer with the largest areal extent and the most data, are similar to the range and frequency distribution of pumping-test tansmissivities. Although there are fewer pumping tests in the Paluxy and Woodbine, the frequency distribution of estimated transmissivities in these aquifers is similar to that of transmissivities in the Hosston/Trinity, suggesting that, because the depositional histories of the aquifers are somewhat comparable, the estimated transmissivities are probably valid representations of actual transmissivity. In the Hosston/Trinity study area, transmissivity generally increases basinward as the aquifer increases in thickness, although the hydraulic conductivity decreases, an indication of a decrease in sediment size or degree of sorting. In the Paluxy aquifer, both transmissivity and hydraulic conductivity increase somewhat toward the basin, which may imply that diagenesis has enhanced hydraulic conductivity in the basin ward parts of the aquifer or that the grain size is larger or that sorting is better. In the Woodbine aquifer, although the deposition axis is nearly normal to that of the other formations, the relationships are similar to those of the Paluxy aquifer. (Baker-IVI)
W84-02811

UPDATED RADIOISOTOPE STUDIES IN ZIMBABWEAN GROUND WATERS,
Ministry of Water Development, Salisbury (Zimbabwe). Hydrological Branch.
P. Wurzel.
Ground Water, Vol. 21, No. 5, p 597-605, September-October, 1983. 8 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater, *Water supply, Zimbabwe, Sabi Valley, Alluvial plains, Reservoirs, Radioactive tracers, Potentiometry, Boreholes, Geohydrology.

The groundwater hydrology of the Sabi Valley alluvial plain, the largest tract of alluvium in Zimbabwe, was studied by three independent methods: the classical approach of potentiometric surface construction and pump test analyses, the use of in-borehole velocity and direction measurements with artificial radioactive isotopes applied to the point-dilution techniques, and a natual and thermonuclear tritium survey. The three methods of approach produced remarkably close values for the groundwater throughflow within the plain. In terms of the physical size of the basin and thus amount of water stored, the following values exist: mean aquifer thickness of 40 m, mean porosity of 15%, and an areal extent of the aquifer of 300 sq km, producing a storage volume of 2 x 10 to the 9th power cu m. However, it is usual in confined aquifers to assign greater weight to the rate concept when discussing safe yield, in which case the safe yield of 2.6 m/sec is currently based on evidence from three independent techniques, and is used for the planning of conjunctive utilization of ground water and surface water. (Baker-IVI)
W84-02812

EFFECTS OF AQUIFER INTERCONNECTION RESULTING FROM UNDERGROUND COAL GASIFICATION,
Lawrence Livermore National Lab., CA.
R. Stone, E. Raber, and A. M. Winslow.
Ground Water, Vol. 21, No. 5, p 606-618, September-October, 1983. 15 Fig, 2 Tab, 14 Ref.

Descriptors: *Aquifer system, *Environmental effects, *Coal gasification, Powder River Basin, Wyoming, Groundwater movement, Permeability coefficient, Flow patterns.

The effects of aquifer interconnection caused by the collapse of cavities formed in coal seams by two small underground coal gasification experiments in the Powder River Basin, Wyoming were explored. The magnitude and extent of changes in

groundwater flow patterns near the site of the experiments were measured. A steady state groundwater flow model of the interconnection zone at each site was constructed using hydraulic head measurements in the three affected aquifers. Water from one or both of the upper aquifers entered the collapse rubble and flowed down to the lowest aquifer (the gasified coal seam) where it flowed away from the collapse zones. The hydraulic conductivity of the collapse rubble is less than that of the aquifers and provides only a very moderately permeable interconnection between them. A marked reduction in the hydraulic conductivity of the gasified coal seam near the collapse zones causes restriction of flow in the seam, away from them. Changes in hydraulic head and flow patterns caused by aquifer interconnection extend generally only 200-300 ft (60-90 m) away from the experiment sites. Flow in the uppermost aquifer at one of the sites may be influenced as far as 400 ft (122 m) away. At both experiment sites, aquifer interconnection allows water from the uppermost (sand) aquifer, which contains the poorest quality water of the three aquifers, to enter one or both of the underlying coal aquifers. (Baker-IVI)
W84-02813

AN APPLICATION OF GEOSTATISTICS TO DETERMINE REGIONAL GROUND-WATER FLOW IN THE SAN ANDRES FORMATION, TEXAS AND NEW MEXICO,
Texas Univ. at Austin. Bureau of Economic Geology.
E. D. Orr, and A. R. Dutton.
Ground Water, Vol. 21, No. 5, p 619-624, September-October, 1983. 6 Fig, 15 Ref.

Descriptors: *Groundwater movement, *Statistical methods, *San Andres Formation, *Texas, *New Mexico, Geologic mapping, Hydraulic head, Kriging.

Problems were encountered during attempts to construct a contour map of hydraulic head for groundwater in the San Andres Formation in west Texas and eastern New Mexico. Variability in quality and distribution of data were responsible for some of the difficulties. Only in the northern part of the study area can the direction of regional groundwater flow be inferred from raw data where reliable drill-stem tests and water level measurements make up most of the data. Unreliable and highly variable drill stem tests comprise the bulk of the data in the southern area. Variogram analysis and kriging successfully remove the effects of high measurement error, allowing the regional trend to be seen. However, kriged block estimates could not be computed for a critical region with sparse data in the northeastern part of the study area. The most complete potentiometric surface can be contoured from hybrid data: kriged block estimates from the southern region, and original head measurements in the northern region. (Baker-IVI)
W84-02814

HEAT CONVECTION IN WARM SPRINGS VALLEY, VIRGINIA,
ERTEC, Inc., Long Beach, CA.
A. P. Severini, and D. Huntley.
Ground Water, Vol. 21, No. 6, p 726-732, November-December, 1983. 9 Fig, 21 Ref.

Descriptors: *Hot springs, *Convection, *Groundwater, *Warm Springs Valley, *Virginia, Water temperature, Permeability, Geohydrology.

The importance of free and forced convection on the occurrence of hot springs in Warm Springs Valley, Virginia, was investigated. Hydrogeologic controls were established on the convection system and it was determined whether or not, using a normal geothermal gradient and measured hydrogeologic parameters, convection alone could account for spring temperatures on the order of 40 degrees C. Standard field hydrogeologic investigation techniques with a two-dimensional numerical model of a cross section of the Warm Springs Valley system were used. In order to produce the observed groundwater temperatures in the discharge areas ground water must circulate to depths of about 5 km, must have a vertical zone of enhanced permeability in the discharge area, must have a horizontal zone of enhanced permeability near the 5 km depth of circulation, and should have relatively low permeabilities in the recharge area. All of these constraints are compatible with the geology found in the Warm Springs Valley area. (Baker-IVI)
W84-02818

GROUND-WATER MODELING IN A SOUTHWESTERN ALLUVIAL BASIN,
Hargis and Montgomery, Inc., Tucson, AZ.
D. B. Hawkins, and D. B. Stephens.
Ground Water, Vol. 21, No. 6, p 733-739, November-December, 1983. 14 Fig, 17 Ref.

Descriptors: *Groundwater movement, *Model studies, Alluvial basins, Animas Valley, New Mexico, Computer models, Kriging, Water level, Transmissivity.

A groundwater flow system in an alluvial basin in Animas Valley, New Mexico was modeled using a two-dimensional finite-difference computer code. The transmissivity distribution for the model was determined using a three-step approach. First, values of the nature logarithm of transmissivity were interpolated from existing data using the kriging technique. This interpolation scheme also produced a map of standard deviations of the kriging errors. Secondly, a conventional flow net was drawn from steady state water levels with the aid of the kriged hydraulic head distribution. Thirdly, the approximate transmissivity map, the standard deviation map of the kriged log of transmissivity values, and flow net were used to select the segment of each stream tube where transmissivity was known with the greatest certainty. Then, transmissivities in other segments of the stream tubes were calculated from Darcy's Law. This distribution, when input to the numerical model, did not have to be altered appreciably during the calibration for a steady state and seven year transient period. Most of the transient calibration was accomplished by adjusting storage coefficients. Considering the uncertainity in the available pumping data, very good agreement was found between observed and predicted water levels during a four year model verification period, in spite of likely errors in total pumpage and the approximate methods used to assign pumping rates. (Baker-IVI)
W84-02819

EXPERIMENTAL STUDY OF SOME HYDROGEOPHYSICAL PROPERTIES OF UNCONSOLIDATED POROUS MEDIA,
Consiglio Nazionale delle Ricerche, Milan (Italy). Ist. per la Geofisica della Litosfera.
G. Biella, A. Lozej, and I. Tabacco.
Ground Water, Vol. 21, No. 6, p 741-751, November-December, 1983. 10 Fig, 3 Tab, 42 Ref.

Descriptors: *Aquifer characteristics, *Porous media, Permeability, Porosity, Natural waters, Sand, Particle size.

One- and two-component artificial sand samples were used to estimate the relations between formation factor, porosity, and permeability. Determinations of formation factor values with different porewater resistivity for different samples indicated that under these experimental conditions the measured formation factor approaches the intrinsic formation factor. The relationship between intrinsic formation factor and porosity does not depend on grain size and size distribution. In the range between 100 and 40% of the small component, both porosity and permeability in the two-component samples decrease with the small-component percentage; while porosity is independent of grain size, permeability values are strictly controlled by the small component size which dominates the structure of the assemblage. When studying natural formations with clean sand, the general conclusions are very different and particularly the size distribution is more complex. In this case it seems to be at least necessary to determine a mean grain size value corresponding to the effective size, and measure or estimate a value approaching the intrinsic formation factor by making the suitable corrections. (Baker-IVI)
W84-02820

GROUNDWATER RECHARGE ESTIMATES FOR TWO BASINS IN THE DECCAN TRAP BASALT FORMATION,
National Geophysical Research Inst., Hyderabad (India).
R. N. Athavale, R. Chand, and R. Rangarajan.
Hydrological Sciences Journal, Vol. 28, No. 4, p 525-538, December, 1983. 6 Fig, 5 Tab, 10 Ref.

Descriptors: *Groundwater recharge, *Monsoons, *Deccan Trap, Kukadi basin, Godavari-Purna basin, India, Tritium, Water level fluctuations, Evaporation, Percolation.

Recharge to phreatic aquifers in the Deccan Trap basalt formation due to 1980 precipitation was determined in the Kukadi and Godavari-Purna basins (India) by tritium injection. Tritium was injected in June 1980, just before the onset of monsoon, at a depth of 60 cm; vertical soil profiles were collected after the monsoon and also at the end of the hydrological year, i.e. in May 1981. Laboratory measurements of variation in moisture percentage and tritium concentration with depth were used in estimation of recharge. Recharge values for 19 sites in Kukadi basin varied from 135 to -8 mm while those for 24 sites in Godavari-Purna basin varied from 208 to -28 mm, giving mean values as 46 and 56 mm respectively. Annual input to the groundwater reserves of the two basins was calculated as 31.9 and 35.4 million cu m respectively. A qualitative correlation between recharge values and water level fluctuation data for dug wells was observed and a reasonable agreement with hydrogeological estimates of recharge was also found. The effect of evaporation in dry summer months on moisture in the deep percolation zone was evaluated through comparison of post-monsoon 1980 and pre-monsoon 1981 recharge values. (Author's abstract)
W84-02830

ESTIMATION OF GROUNDWATER RECHARGE PARAMETERS BY TIME SERIES ANALYSIS,
Geological Survey, Denver, CO.
R. L. Naff, and A. L. Gutjahr.
Water Resources Research, Vol. 19, No. 6, p 1531-1546, December, 1983. 22 Fig, 3 Tab, 17 Ref, 2 Append.

Descriptors: *Time series analysis, *Groundwater recharge, Precipitation, Dupuit aquifers, Water level fluctuations, Effective precipitation, Mathematical models.

A model is proposed that relates water level fluctuations in a Dupuit aquifer to effective precipitation at the top of the unsaturated zone. Effective precipitation, defined as that portion of precipitation which becomes recharge, is related to precipitation measured in a nearby gage by a two-parameter function. A second-order stationary assumption is used to connect the spectra of effective precipitation and water level fluctuations. Measured precipitation is assumed to be Gaussian, in order to develop a transfer function that relates the spectra of measured and effective precipitation. A nonlinear least squares technique is proposed for estimating parameters of the effective-precipitation function. Although assumptions of Gaussian precipitation and of a constant loss factor are restrictive, results from the case studies show that the procedure yields reasonable results that are acceptable, as indicated by the overall small model variances of the case studies. One problem is sensitivity to both form and scale of the covariance function used for precipitation. Consequently, identification of the appropriate covariance type is an important factor for use of the method. The loss factor is the more sensitive parameter to estimate of the two parameters studied. It has a greater variability and is more likely to be misestimated. (Moore-IVI)
W84-02855

SLUG TESTS IN FISSURED AQUIFERS,
Institute of Geological Sciences, Edinburgh (Scotland).
J. A. Barker, and J. H. Black.
Water Resources Research, Vol. 19, No. 6, p 1558-1564, December, 1983. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Slug tests, *Fissured aquifers, Transmissivity, Storage coefficient, Estimation, Aquifer testing, Mathematical models.

A simple model of a slug test in a fissured aquifer has been studied in order to gain insight into the difficulties of interpreting data from such tests. The model is used to estimate the errors that would result from applying the standard type curve analysis to fissured aquifers. It is found that the derived aquifer transmissivity will always be overestimated, but by a factor which is unlikely to exceed 3. By contrast, the derived storage coefficient can be in error by a factor ranging from 10 to the -6th to 10 to the 5th. The volume of the aquifer influenced by a slug test is investigated, and a simple formula for estimating the range of a test is suggested. (Author's abstract)
W84-02861

GEODETIC EVIDENCE FOR SUBSIDENCE DUE TO GROUNDWATER WITHDRAWAL IN MANY PARTS OF THE UNITED STATES OF AMERICA,
Cornell Univ., Ithaca, NY. Dept. of Geological Sciences.
S. C. Chi, and R. E. Reilinger.
Journal of Hydrology, Vol. 67, No. 1-4, p 155-182, 1984. 10 Fig, 2 Tab, 69 Ref. NASA grant NAG5-40, USGS grant 14-08-0001-17625.

Descriptors: *Geodetics, *Subsidence, *Groundwater recession, Groundwater depletion, Groundwater level, Consolidation sedimentation, Tectonics, Uplift pressure.

Analysis of repeated levelings conducted by the National Geodetic Survey indicates many locations of relative subsidence in the U.S.A. Specific criteria are used to identify those subsidence features which most likely result from sediment compaction due to lowering of water levels in underground aquifer systems. Previously reported areas of such subsidence include: south-central Arizona; Savannah, Georgia; Pecos and Houston-Galveston, Texas; Denver, Colorado; San Joaquin Valley, Santa Clara Valley, Saugus Basin, Los Angeles Basin and Bunker Hill-San Timoteo, California; Milford, Utah; Raft River Valley, Idaho; Baton Rouge and New Orleans, Louisiana; and Las Vegas, Nevada. Analysis indicates that such subsidence is more widespread than previously reported occurring in a number of locations within the Atlantic and Gulf of Mexico coastal plains and along the Mississippi Valley as well as in many other unconsolidated sedimentary basins from which groundwater has been extracted and for which repeated leveling measurements are available. Identified are more than 30 new locations of subsidence possibly due to water withdrawal. The best documented of these include: Ventura, Ontario and San Pedro-Santa Monica, California; Monroe and Alexandria, Louisiana, and Jackson, Mississippi. Subsidence in newly identified locations ranges from several tens of millimeters to a few hundred millimeters over distances of approximately 10-60 km and times of 2-48 yr. Subsidence may also have occurred in other groundwater basins where water levels have been drawn down, and remained undetected because of a lack of repeated levelings. It is important to be aware of and to continue to monitor such effects because of increasing rates of utilization of groundwater resources and the potential for significant engineering problems due to surface movements. In addition, identifying cases of subsidence due to water withdrawal is essential in order to use effectively releveling observations for investigating tectonic deformation. Along these lines, the analysis suggests that some of the releveling observations used to define a region of tectonic uplift in southern California more likely reflect subsidence due to water-level declines within sedimentary basins around the periphery of the presumed zone of uplift. (Murphy-IVI)
W84-02892

THE CAPILLARY FRINGE AND ITS EFFECT ON WATER-TABLE RESPONSE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. W. Gillham.
Journal of Hydrology, Vol. 67, No. 1-4, p 307-324, 1984. 12 Fig, 14 Ref.

Descriptors: *Capillary fringe, *Water table, Water table fluctuations, Moisture tension, Groundwater recharge, Capillary capacity, Capillary conductivity, Water table rise.

Shallow water tables are often observed to respond in a highly disproportionate manner to precipitation events. That is, the magnitude of the response is often much greater than would be predicted on the basis of the specific yield of the geologic material and the amount of rainfall. If the capillary fringe (the zone of tension saturation) extends to ground surface, then the addition of a very small amount of water can result in an immediate and large rise in the water table. A field experiment in which the addition of 0.3 cm of water caused the water table to rise 30 cm in 0.25 min. supports the arguments, thus demonstrating the large and highly transient influence of the capillary fringe on the position of the water table. The capillary-fringe effect could have a major influence on the process of streamflow generation, contaminant transport to surface waters and contaminant transport in hydrogeologic regimes having shallow water tables. The calculations of groundwater recharge and consumptive use, based on water-table response and an assumed specific yield, could be substantially in error. (Murphy-IVI)
W84-02900

SOIL SURFACE EVAPORATION AND WATER TABLE DEPTHS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W84-02925

2G. Water In Soils

SOIL MOISTURE INFLUENCE ON MICRONUTRIENT CATION AVAILABILITY UNDER AEROBIC CONDITIONS,
Texas Agricultural Experiment Station, College Station.
A. I. Adam, and W. B. Anderson.
Plant and Soil, Vol. 72, No. 1, p 77-83, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Soil water, *Micronutrients, *Aerobic conditions, Microorganisms, Copper, Iron, Manganese, Zinc, Climate, Sudan.

The three major soils series comprising the Gezira scheme (Sudan) are Hosh, Suleimi, and Laota. Surface soil samples from each soil series were employed to study the effect of soil moisture on the DTPA-extractable micronutrient cation under aerobic conditions. The study continued for 8 weeks using an incubation technique at two levels of soil moisture (continuously moist and moist/dry cyles). The DTPA-extractable Cu, Fe, Mn and Zn from air-dry soil samples were much higher compared to values from their incubated counterparts. For the three soils the CO2 production (microbial activity) reached the maximum in 5 weeks and then levelled off while the lowest values of micronutrient cation from the incubated soils were obtained between 2 to 8 weeks. (Author's abstract)
W84-02503

SORPTION PROCESSES IN SOILS AS INFLUENCED BY PORE WATER VELOCITY: 2. EXPERIMENTAL RESULTS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
S. Akratanakul, L. Boersma, and G. O. Klock.
Soil Science, Vol. 135, No. 6, p 331-341, June, 1983. 9 Fig, 6 Tab, 3 Ref.

Descriptors: *Interstitial water, *Cadmium, *Soil water, *Adsorption, Interstitial water velocity, Diffusion, Soil solution.

Experiments were carried out to measure the rate of adsorption of cadmium for static and dynamic flow conditions. The water content of samples was maintained at -12.6 kPa, corresponding to 87% of saturation. Adsorption rates at apparent pore water velocities (v) of 1.3, 2.3, and 2.7 cm/h were measured. Diffusive conductance, Kd, and forward (k1) and backward (k2) rate constants were calculated using the Nelder-Mead Simplex method based on a nonlinear least-square procedure. Values of Kd and of the ratio k1/k2 increased with increasing pore water velocity. The rate of adsorption was higher in a sample with solution flowing through it than in a sample with the same solution under static conditions. The magnitude of Kd ranged from 0.00007 at static conditions to 0.0004/s with v = 2.7 cm/h. Results imply that the thickness of the subsurface layer decreases with v, thus increasing the diffusion rate of ions across this layer. When the adsorption process is far from equilibrium, diffusion across the subsurface layer became a rate-limiting step in the adsorption process. Lateral diffusion cannot be ignored in studies of the kinetics of adsorption. The increase in values of k1/k2 with increasing v indicates that the surface reaction proceeded at a more rapid rate in the presence of a continuous supply of solution. Flowing solution serves as a continuous source of the introduced ions, as well as a continuous sink for the desorbed ions of other species originally present. The accelerated rate of adsorption induced by flow of solution through the soil may be attributed both to an increase in the rate of diffusion as the thickness of the subsurface layer decreases and to an increase in rate of the kinetic reactions at the surface as the exchange process proceeds in the presence of the continuous sink. (Authro's abstract)
W84-02514

COMPARISON OF SOIL WATER INFILTRATION PROFILES OBTAINED EXPERIMENTALLY AND BY SOLUTION OF RICHARDS' EQUATION,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
R. J. Kunze, and D. R. Nielsen.
Soil Science, Vol. 135, No. 6, p 342-349, June, 1983. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Infiltration, *Soil water, Permeability coefficient, Diffusivity, Water content, Wetting, Mathematical studies.

Hesperia and Columbia soil experimental infiltration data are compared to calculated profiles obtained by solutions of Richards' equation requiring soil water diffusivity D and hydraulic conductivity K as functions of the water content theta. The calculations were made using a finite-difference, iterative method (FINDIT). Predicting wetting profiles by this method is somewhat more rigorous than some other solutions of Richards' equation. The method reduces calculations for infiltration to a two-term algebraic equation, partitions infiltration into matric and gravitational components, and gives an asymptotic relationship between the infiltration rate and the saturated conductivity as time approaches infinity. An array of solutions for the two indicated soils, obtained with and without the diffusion lip procedure, raises questions of the need for its use. A new method for estimating the lambda - theta area in horizontal infiltration analysis, using only diffusivity data, gives estimates to less than 3% of the final value. Integrated mean values of D and K were required for accurately predicting soil moisture wetting profiles over a range of time periods and theta divisions. Arithmetic and geometric means and nonaveraged values, particularly of D, produced unreliable wetting profiles. (Author's abstract)
W84-02515

CULTIVATION AND EVAPORATIVITY EFFECTS ON THE DRYING PATTERNS OF SANDY LOAM SOIL,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
For primary bibliographic entry see Field 3F.
W84-02516

A REEXAMINATION OF THE CONSTANT HEAD WELL PERMEAMETER METHOD FOR MEASURING SATURATED HYDRAULIC CONDUCTIVITY ABOVE THE WATER TABLE,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, D. E. Elrick, and G. C. Topp.
Soil Science, Vol. 136, No. 4, p 250-268, October, 1983. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Permeability coefficient, *Soil saturation, Permeameters, Hydraulic pressure, Steady-state flow, Wells, Estimation, Mathematical analysis.

Although the constant head well permeameter method for field measurement of field-saturated hydraulic conductivity above the water table has several advantages over other methods. it has not been widely used due to a tendency to underestimate hydraulic conductivity relative to other methods. A theoretical analysis of steady-state flow out of a well situated above the water table reveals that the underestimation is at least partially due to the inaccurate analytical solution used to approximate the vertical and horizontal hydraulic pressure gradient distributions along the wall and base of the well. Derivation of a more accurate analytical approximation of the gradient distributions resulted in an increase in the hydraulic conductivity estimate of about 40% and a numerical approximation of the gradient distributions resulted in an increase of 60%. Using the numerical solution, the constant head well permeameter method produced estimates of the saturated conductivity of a structureless sandy soil that were statistically equivalent to the estimates produced by the air entry permeameter method. This improvement thus eliminates, at least within the limits of the tests, the previous tendency of the constant head well permeameter method to underestimate the hydraulic conductivity. The improvements in practical application, which result from refinements in apparatus design, increase the efficiency and range of operation of the method. (Moore-IVI)
W84-02519

A STOCHASTIC ANALYSIS OF MACROSCOPIC DISPERSION IN FRACTURED MEDIA,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, L. Smith, and A. S. Crowe.
Water Resources Research, Vol. 19, No. 5, p 1253-1265, October, 1983. 11 Fig, 2 Tab, 26 Ref.

Descriptors: *Mass transport, *Geologic fractures, *Dispersion, *Stochastic process, Model studies, Groundwater movement, Diffusion, Hydraulic gradient.

A stochastic modeling technique has been developed to investigate mass transport in a network of discrete fractures. The model is based on the repetitive generation of realizations of a fracture network from probability distributions, describing the fracture geometry, and on a solution for mass transport within each network, using a particle-tracking technique. The system consists of two orthogonal fracture sets of finite length, oriented at various angles with respect to the direction of the mean hydraulic gradient. Emphasis is placed on describing the character of dispersion, which develops as a consequence of fracture interconnectivity, and on testing the validity of the conventional diffusion-based model of dispersion in describing transport in fractured media. Results show that mass distributions have a complex form. Marked longitudinal dispersion can develop even a short distance from a source. The distribution of mass in the direction of flow has a consistent negative skew. This pattern of dispersion arises from the limited number of pathways for mass to migrate through the network. Controlling factors in the transport process are the orientation of the fracture sets with respect to the mean hydraulic gradient, the difference in the mean flow velocity in the two fracture sets, and the standard deviation in velocity for fracture set 1. Transport patterns can change greatly as the orientation of the hydraulic gradient changes with respect to the two fracture sets. A conventional diffusion-based model of dispersion cannot characterize transport in these fracture networks. A skewed spatial distribution of mass is observed much more frequently than a Gaussian distribution. When the mean velocities in the two fracture sets are not equal, the form of mass spreading is described by a more general, skewed distribution that accounts for the bias in the probability of mass moving along one fracture set over another. There is a tendency for mass to form a more symmetric distribution as the orientation of the two fracture sets is rotated toward a 45 degree angle with respect to the direction of the mean hydraulic gradient. Furthermore, constant dispersivity values or simple dispersivity functions are not definable because of the sensitivity of transport to the local velocity field in the fracture network. (Author's abstract)
W84-02766

TIME-DEPENDENT LINEARIZED TWO-DIMENSIONAL INFILTRATION AND EVAPORATION FROM NONUNIFORM AND PERIODIC STRIP SOURCES,
Auburn Univ., AL. Dept. of Civil Engineering.
V. Batu.
Water Resources Research, Vol. 19, No. 6, p 1523-1529, December, 1983. 7 Fig, 16 Ref.

Descriptors: *Infiltration, *Evaporation, *Soil surfaces, Mathematical models, Permeability coefficient, Soil water, Matric flux potential, Irrigation systems, Porous media.

Using a linearized partial differential equation describing unsaturated, homogeneous, and isotropic porous media flow, a general two-dimensional time-dependent mathematical model is presented for infiltration and infiltration-evaporation cases from nonuniform and periodic strip sources located at the soil surface. The analysis is based on an exponential relationship between the unsaturated hydraulic conductivity and the soil water pressure head and also assumes a constant value for the derivative of unsaturated hydraulic conductivity with respect to water content. In the mathematical analysis, Laplace transform and Fourier analysis techniques are used simultaneously, and a general equation is obtained in series-integral form for the distribution of matric flux potential. The solution for uniform infiltration from equally spaced strip sources and uniform evaporation from the rest of the strips is presented as a special case of the general model. Another special case is presented for infiltration from equally spaced strip sources. The results of this latter case are compared with Warrick and Lomen (Soil Sci. Soc. Am. J,. 40, 639-643, 1976), and it is observed that the agreement is reasonably good. All results are expressed in integral forms and are calculated by using a numerical integration method. Equations for the horizontal and vertical flux components for the special case are presented. The solutions predict that matric flux potential and flux components as functions of space and time. They are of interest in the design of irrigation systems and may be used also for different purposes in other engineering applications. (Author's abstract)
W84-02854

WATER MOVEMENT INTO SEASONALLY FROZEN SOILS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. L. Kane, and J. Stein.
Water Resources Research, Vol. 19, No. 6, p 1547-1557, December, 1983. 11 Fig, 2 Tab, 17 Ref. OWRT project A-068-ALAS.

Descriptors: *Infiltration, *Snowmelt, *Soil water, *Frozen soils, Pore pressure, Gravitational gradient, Ice, Silt loam, Alaska, Fairbanks.

Depending upon the total (water and ice) soil moisture conditions near the ground surface, a wide range of infiltration rates can exist. This disparity in the infiltration rate results in considerable variation in the amount of snowmelt runoff. The field site for investigating infiltration properties of seasonally frozen soils was located just north of Fairbanks, Alaska. The area selected is on a permafrost-free, south-facing slope. The predominant soil type in this area is Fairbanks silt loam. Double-ring infiltrometers were installed to measure to infiltration properties of the frozen soil. Soil samples were collected to a depth of 1 m, and the gravimetric method was used to determine moisture contents for 5-cm increments. The two main forces responsible for the infiltration rate into seasonally frozen soils are the pore-pressure (matrix) gradient and gravitational gradient. When the infiltration rate at equilibrium exceeds the hydraulic conductivity at saturation, the pore-pressure gradient is greater than zero and is responsible for the additional flow. The pore-pressure gradient is greatest initially and it rapidly approaches zero when the gravitational gradient is dominant. The gravitational gradient is the only gradient that exists when equilibrium conditions prevail. Depending upon the total moisture content prior to infiltration from snowmelt, a range of infiltration rates will be observed for each soil type. Higher infiltration rates will be observed for drier soils and lower infiltration rates for ice-rich soils. Using the equilibrium infiltration rate during the entire melt period should not lead to significant error when predicting runoff and infiltration quantities. Snowmelt events last for several days or even weeks, and the infiltration rate usually approaches equilibrium conditional within an hour, and variations from the equilibrium infiltration infiltration rate only last for short periods of time. (Moore-IVI)
W84-02856

OPTIMIZATION OF PARAMETERS IN A MODEL OF SOIL WATER DRAINAGE,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Div. of Tropical Crops and Pastures.
B. H. Wall, and A. J. Miller.
Water Resources Research, Vol. 19, No. 6, p 1565-1572, December, 1983. 2 Fig, 2 Tab, 29 Ref, 1 Append.

Descriptors: *Soil water, *Permeability coefficient, *Drainage, Soil matric potential, Mathematical models, Soil moisture depletion.

A serious obstacle to widespread application of soil water flow theory to small plots is the difficulty of specifying the moisture characteristics psi(theta, z), and conductivity characteristics K(theta, z), in the face of lateral heterogeneity of these properties. A method is presented for the simultaneous determination of effective in situ psi(theta, z) and K(theta, z), given only soil moisture depletion data. The procedure uses a nonlinear least squares fitting routine to find a psi(theta, z) which, with its related K(theta, z), produces calculated fluxes matching those observed. The agreement is an order of magnitude better than that obtained using characteristics determined from laboratory measurements on field samples. (Author's abstract)
W84-02857

MONITORING THE UNFROZEN WATER CONTENT OF SOIL AND SNOW USING TIME DOMAIN REFLECTOMETRY,
Alaska Univ., Fairbanks. Inst. of Water Resources.
J. Stein, and D. L. Kane.
Water Resources Research, Vol. 19, No. 6, p 1573-1584, December, 1983. 12 Fig, 2 Tab, 19 Ref.

Descriptors: *Time domain reflectometry, *Soil water, *Snow, *Snowmelt, Reflectrometry, Infiltration, Snow density.

Time domain reflectometry (TDR) is a technique that can be used to indirectly measure the in situ moisture content of soil. Previously, this method was not used in the field to continuously monitor the liquid water content because of the influence it had on the wetting, drying, freezing and thawing cycles of the soil. The principal objectives of this field investigation were, apply the TDR technique to monitor the unfrozen water content in the soil, utilize this technique to determine snowmelt infiltration into seasonally frozen soils, and explore the feasibility of using the TDR technique to monitor snowmelt percolation in the snowpack. An additional goal of this paper was to explain in a straightforward manner how to use the TDR technique to obtain the liquid water profile in a soil. Various configurations of parallel transmission

lines were installed horizontally at various depths in the soil and also in the snowpack. This technique gave a good delineation of the unfrozen water content with depth in frozen soils. Results looked promising in snow if in situ snow density measurements were taken along with the TDR measurements. (Author's abstract)
W84-02862

SENSITIVITY ANALYSIS OF A LUMPED-PARAMETER MODEL FOR INFILTRATION,
Helsinki Univ. of Technology, Espoo (Finland). Systems Theory Lab.
K. Pingoud.
Journal of Hydrology, Vol. 67, No. 1-4, p 97-113, 1984. 4 Fig, 15 Ref, 2 Append.

Descriptors: *Infiltration, *Sensitivity analysis, Mathematical models, Rainfall, Soil saturation.

Sensitivity analysis provides a useful tool that can be conveniently applied to study the properties of the lumped-parameter model for infiltration. The sensitivities of the momentary infiltration rate and cumulative infiltration are clear measures for the behavior of the model. The scaled representation of the model used in the computations has the advantage that the numerical results obtained can be directly applied to different combinations of the parameter values in the original model. One question is the sensitivity to the initial value of the soil saturation. Only the model behavior during constant rainfalls is considered, implying that the soil is in a wetting phase all the time. One aim of the analysis is to study qualitatively the properties of the model structure. Reasonable values for the optimal parameters in a practical application can be estimated on the basis of the sensitivity functions. (Moore-IVI)
W84-02888

SOIL-WATER RESIDENCE TIME AND SOLUTE UPTAKE,
Sheffield Univ. (England). Dept. of Geography.
K. R. J. Smettem.
Journal of Hydrology, Vol. 67, No. 1-4, p 235-248, 1984. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Soil moisture retention, *Solutes, Soil water, Soil chemistry, Solute transport, Soil properties.

There is a need to evaluate whether analytical solutions based on the concept of physical nonequilibrium are capable of describing solute transfer in undisturbed field soils. This study used undisturbed soil cores in order to provide data against which a suitable analytical model could be tested. Measured breakthrough curves were well described by an analytical solution incorporating mobile and stagnant regions with sideward exchange. Resulting transport parameters were dependent upon the input flux rate, reflecting a pattern of increasing breakthrough curve asymmetry with increasing flux. This was attributed to the combined influences of pedal by-passing and increasing non-equilibrium for diffusion-controlled solute transfer between the mobile and stagnant regions. The stagnant region model is adequate for describing solute transport in a well-structured undisturbed field soil. (Murphy-IVI)
W84-02895

THE MOVEMENT OF WATER THROUGH CORES OF A DRY (CRACKED) CLAY-LOAM GRASSLAND TOPSOIL,
Oxford Univ. (England). Dept. of Agricultural Science.
W. R. Kneale, and R. E. White.
Journal of Hydrology, Vol. 67, No. 1-4, p 361-365, 1984. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Soil water, *Rainfall, *Grasslands, Clays, Topsoil, Permeability, Loam, Infiltration, Soil moisture deficit, England.

Soil cores were taken from the Ah horizon of a grassland field in the Wytham catchment near Oxford, England. The soil was dry and cracks were well developed. The initial volumetric moisture contents of the cores were in the range of 0.26-0.30 cu m/cu m, corresponding approximately to wilting point compared to total porosities of 0.63-0.66 cu m/cu m. At the lowest application rate, 2.2 mm/hr, a total of 17.6 mm of water was applied without producing any flow of water from the base of the core. Bypassing did not occur and the infiltration rate into the surface peds equalled the application rate. At the other rates of application, 3.6, 11.9, and 21.2 mm/hr, outflow from the cores was first noted after the application of 2.7, 3.2, and 3.4 mm of water, respectively. Once outflow started it rapidly achieved a steady state at a rate lower than the application rate. It was estimated that 10-20% of rainfall bypassed the top 0.09 m of this grassland soil during periods of summer soil-moisture deficit. (Baker-IVI)
W84-02902

NITROGEN AND PHOSPHORUS FLUXES FROM A FLOODED ORGANIC SOIL,
Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 2K.
W84-02908

INTERFACING SOIL MOISTURE GYPSUM BLOCKS WITH A MODERN DATA-LOGGING SYSTEM USING A SIMPLE, LOW-COST, DC METHOD,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 7B.
W84-02909

2H. Lakes

SEASONAL CHANGE OF DENSITY STRATIFIED LAYER IN KATSURAZAWA RESERVOIR,
Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
M. Ohtani, and I. Yakuwa.
Japanese Journal of Limnolology, Vol. 44, No. 3, p 206-214, July, 1983. 76 Fig, 2 Tab.

Descriptors: *Reservoirs, *Density stratification, *Seasonal variation, *Katsurazawa Reservoir, Japan, Water temperature, Suspended solids, Thermoclines, Snowmelt.

The seasonal variation of water temperature and suspended solid concentrations (SS) were measured in Katsurazawa Reservoir in a period from May, 1978 to April, 1979. Measurements were carried out at a station 50-100 m from the damsite. In early spring the reservoir was filled with water of low temperature and high SS which was caused by the melting snow. The inflow water formed the transitional SS layer at the same depth as thermocline in spring and early summer. In the circulation period after summer, both the thermocline and the SS transitional layer descended toward the bottom. In November and December, the latter remained at a depth of about 30 m after the former had disappeared, showing that the thickness of the surface mixing layer could not be adequately estimated only by the apparent thermocline. Concentration of SS increases exponentially with depth in each of the surface and the bottom layers. The vertical gradients change under the influence of seasonal climate condition. In the heating period, water density of the surface layer is much lower than in the bottom layer, and so the density stratification is stable. On the other hand, the gradient of vertical distribution of water density is small and the stratification is unstable in the cooling period. (Author's abstract)
W84-02481

THE IMPORTANCE OF FRACTIONAL LIGHT ABSORPTION BY PHOTOSYNTHETIC PIGMENTS FOR PHYTOPLANKTON PRODUCTIVITY IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. M. Tilzer.
Limnology and Oceanography, Vol. 28, No. 5, p 833-846, September, 1983. 5 Fig, 1 Tab, 35 Ref. Deutsche Forschungsgemeinschaft grants Ti 115/3 and Ti 115/10-2.

Descriptors: *Phytoplankton, *Light absorption, *Productivity, *Lake Constance, *Pigments, *Photosynthesis, Biomass, Light attenuation, Light extinction, Pheopigments, Solar radiation, Chlorophyll a, Lakes.

The role of light interception by photosynthetic pigments on the productivity of phytoplankton was studied year-round in mesotrophic Lake Constance. The phytoplankton showed wide seasonal fluctuations in both biomass (Chl a) and photosynthesis. Linear regression was used to determine pigment-specific light attenuation and nonalgal light extinction. Fractional light absorption by photosynthetic pigments ranged from 4 to 70%. Pheopigments comprised 27.4 + or - 8.2% of total pigments. Since pheopigments do not transfer energy to the photosystems, their light absorption must be added to the background light attenuation by nonphotosynthetic material. If pheopigments are considered, estimates of fractional light absorption decrease accordingly. A plot of integral photosynthesis vs. maximum photosynthesis at the depth of the optimum light intensity gives a saturation curve, due to increasing fractional light absorbance by photosynthetic pigments at rising concentrations of biomass. Integral photosynthesis would reach a theoretical upper limit is all light were absorbed by active photosynthetic pigments. Since pheopigment concentrations usually rise with active Chl a, background light attenuation increases also, leading to diminished productivity per unit of lake surface area. (Author's abstract)
W84-02483

CAROTENOID ENHANCEMENT AND ITS ROLE IN MAINTAINING BLUE-GREEN ALGAL (MICROCYSTIS AERUGINOSA) SURFACE BLOOMS,
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 5C.
W84-02484

THE PRODUCTION OF BACTERIA ATTACHED TO PARTICLES SUSPENDED IN A FRESHWATER POND,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
D. Kirchman.
Limnology and Oceanography, Vol. 28, No. 5, p 858-872, September, 1983. 6 Fig, 3 Tab, 56 Ref. NSF grant DEB-79-20909 and NOAA Sea Grant NA81AAA-D-00085.

Descriptors: *Suspended solids, *Bacterial productivity, Ponds, Biomass, Seasonal variation, Detritus, Carbon, Ponds, Metabolism, Glucose, Glutamate, Acetate, Thymidine.

The biomass and activity of particle-bound bacteria in a small freshwater pond were examined during 2 years. The percentage of total bacteria attached to particles was highest (3%) in the months of July through October. During this period the number of bacteria per particle and the number of particles per milliliter were also relatively high. An average attached bacterium was larger than an unattached bacterium in July and August but not in February and May. Cell volumes of both populations were larger in summer than in winter. The uptake of three C14-labeled compounds and the incorporation of (H3) thymidine into marcromolecules were also examined. Although there was no seasonal pattern in the percentage of activity contributed by the >3.0-micro m fraction, this fraction took up relatively more glucose (21% of total uptake) than glutamate (12%) or acetate (6.8%). Thymidine incorporation by the large bacteria was relatively low (2.8%). The production of bacteria attached to particles was estimated from rates of thymidine incorporation and used to estimate the remineralization rate of detrital carbon by particle-bound bacteria. Detrital carbon in Ice House Pond was apparently not

remineralized substantially by particle-bound bacteria. (Author's abstract)
W84-02485

THE CAUSES AND CONSEQUENCES OF SEX-SPECIFIC MORTALITY IN A FRESHWATER COPEPOD,
Rhode Island Univ., Kingston. Dept. of Zoology.
N. G. Hairston, Jr., W. E. Walton, and K. T. Li.
Limnology and Oceanography, Vol. 28, No. 5, p 935-947, September, 1983. 3 Fig, 4 Tab, 31 Ref. NSF grant DEB-8010678.

Descriptors: *Mortality, *Copepods, *Reproduction, *Sex ratio, Sunfish, Predation, Population dynamics, Bullhead Pond, Little Bullhead Pond, Rhode Island.

Skewed adult copepod sex ratios were studied in Bullhead and Little Bullhead Ponds and two temporary ponds in Rhode Island in an attempt to understand the ecological causes and evolutionary consequences of this life-history phenomenon. In ponds containing populations of zooplanktivorous sunfish, female copepods suffered higher mortality rates than males, while in ponds lacking these predators, male and female mortality rates were similar. Field and laboratory experiments showed that females, especially those carrying eggs, were more visible than males and that added visibility accounted for higher predation by fish on these individuals. The cost of carrying eggs was calculated in terms of the decreased population growth rate it produces, and then the magnitude of egg mortality necessary to select for the egg-carrying strategy was estimated. Eggs not carried would have to suffer at least 58% mortality for egg carrying to evolve in the presence of selective fish predation. The response of the copepods to these strong selective pressures lies in a third direction, the production of diapausing eggs. In Bullhead and Little Bullhead Ponds, the copepods begin producing diapausing eggs in late March and early April, just before fish predation becomes intense. (Moore-IVI)
W84-02486

THE EFFECT OF FOOD QUALITY ON FEEDING AND RESPIRATION BY DAPHNIA AND DIAPTOMUS,
Lawrence Univ., Appleton, WI. Dept. of Biology.
S. Richman, and S. I. Dodson.
Limnology and Oceanography, Vol. 28, No. 5, p 948-956, September, 1983. 5 Fig, 1 Tab, 31 Ref.

Descriptors: *Food habits, *Daphnia, *Diaptomus, *Respiration, Cyanophyta, Competition, Eutrophic lakes, Mesotrophic lakes, Oligotrophic lakes, Mathematical models.

Filtering, ingestion, and respiration rates for Daphnia pulex and Diaptomus siciloides were measured in southern Green Bay water mixed with algal cultures to produce varying proportions in blue-green algae. These measurements along with observations of Daphnia mouthpart responses to these foods were used to assess the relative competitive potential of Daphnia and calanoid copepods in lakes of varying trophy. Ratios of filtering and ingestion rate to respiration rate were used as a measure of energy input per unit of energy expended. Passive filtering and subsequent rejection of inedible algae by Daphnia result in higher ratios than those shown by Diaptomus in high quality foods, suggesting a competitive advantage in oligotrophic or mesotrophic lakes. Diaptomus selective feeding, on the other hand, results in higher ratios in the low quality food characteristic of eutrophic conditions. These results and data from the literature are used to propose a two-dimensional niche model to demonstrate the interaction between food quality and abundance on the competitive interaction between calanoid copepods and Daphnia-like cladocerans. (Author's abstract)
W84-02487

FREEZE-OUT OF SALTS IN HARD-WATER LAKES,
Iowa State Univ., Ames. Dept. of Animal Ecology.
D. E. Canfield, Jr., R. W. Bachmann, and M. V. Hoyer.
Limnology and Oceanography, Vol. 28, No. 5, p 970-977, September, 1983. 3 Fig, 4 Tab, 15 Ref. OWRT project A-063-IA.

Descriptors: *Alkalinity, *Hardness, *Freezing, *Melting, Hydrogen ion concentration, Ice cover, Dilution, Salts, Clear Lake, Iowa.

A 15-year series of daily measurements of pH and total alkalinity recorded at the water intake of a municipal water-treatment plant on Clear Lake, Iowa, demonstrated that rapid chemical changes occur annually as the ice cover melts. Additional measurements of total and calcium hardness on this and three other eutrophic, hard-water lakes showed that total and calcium hardness concentrations declined rapidly as the main ice mass was destroyed. The changes in total alkalinity occur within 4-5 days of ice-out. In some years alkalinity in Clear Lake decreases as much as 40 mg/l as CaCO3 in 1 day. This decline was not caused by chemical or biological precipitation of carbonates, but by a dilution effect of melting ice. The rate of reduction is related to the removal rate of the ice cover. The magnitude of the declines could be predicted from measurements of hardness under the ice, lake volume, and volume of ice. The data strongly support the hypothesis that freeze-out of salts during ice formation is responsible for most of the increase in hardness and alkalinity in Iowa lakes and that the subsequent declines in hardness and alkalinity are primarily due to the dilution of lake water by relatively pure meltwater. (Moore-IVI)
W84-02488

COEXISTENCE AND INTERFERENCE IN TWO SUBMERSED FRESHWATER PERENNIAL PLANTS,
Notre Dame Univ., IN. Dept. of Biology.
N. J. McCreary, S. R. Carpenter, and J. E. Chaney.
Oecologia, Vol. 59, No. 2-3, p 393-396, 1983. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Submerged plants, *Eleocharis, *Juncus, Growth, Competition, Interactions, Aquatic environment.

Interactions between two codominant submersed freshwater perennial plants, Eleocharis acicularis (L.) R. and S. and Juncus pelocarpus forma submersus Fassett, were studied in a softwater lake. Analysis of segregation indicated a nonrandom arrangement of individual rosettes of each species with respect to rosettes of the other species. Factors influencing growth of the species were examined using de Wit replacement series replicated four times at five ratios, under three environmental treatments: sphagnum peat, double field density, and shading and a control. Plants grown in pure culture showed no significant difference in yield between the two species. When plants were grown in mixture, there were significant differences between species. Yields of both species were significantly different among environmental treatments. A significant effect of Eleocharis : Juncus ratio in the double density treatment resulted from interference among conspecific neighbors. Relative Yield Totals ranged from 0.84 to 1.0 for all four treatments, and ratios diagrams indicate stable coexistence through the growing season under all four environmental regimes. Interspecific interference was less important than environmental factors and intraspecific interference in determining growth in these experiments. Eleocharis and Juncus are nonrandomly intermingled, and can coexist under a variety of environmental manipulations. This outcome is consistent with their reported distributions in nature. The mechanism that permits this stable coexistence awaits explanation. (Author's abstract)
W84-02492

GROWTH AND PRODUCTION OF SYMPATRIC BROOK AND RAINBOW TROUT IN AN APPALACHIAN STREAM,
Tennessee Univ., Knoxville. Dept. of Forestry, Wildlife and Fisheries.
W. E. Whitworth, and R. J. Strange.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 469-475, July, 1983. 1 Fig, 2 Tab, 31 Ref.

Descriptors: *Trout, *Growth, Biomass, Mortality, Seasonal variation, Fish behavior, Stream fisheries.

A small, second-order stream in the southern Appalachians was sampled every 2 months from September 1978 to October 1979. The 1.5-km study segment was divided into 50, 30-m sections grouped into three areas: a downstream area with only rainbow trout Salmo gairdneri; a middle, mixed-trout area; an upstream area with predominantly brook trout Salvelinus fontinalis. Although a few fish of both species exhibited substantial movements, the majority of fish moved less than 30 m either upstream or downstream. Growth rates of both species were approximately equal until the spring of their second year, when rainbow trout outgrew brook trout and thereafter maintained a size-at-age advantage. Rainbow trout, particularly the 1978 cohort, dominated trout production in the stream. Even in the brook trout area, where the density of 1978 cohort brook trout was twice that of 1978 cohort rainbow trout, rainbow trout outproduced brook trout by 1.20 g/sq m to 1.14 g/sq m. Declining mean biomass of older fish of both species indicates high winter mortality. This, accompanied by slow growth of older fish, resulted in very few fish of either species entering the legal fishery. (Author's abstract)
W84-02522

FOOD PARTITIONING BETWEEN YOUNG OF THE YEAR OF TWO SYMPATRIC TUI CHUB MORPHS,
Colorado Cooperative Fishery Research Unit, Fort Collins.
D. L. Galat, and N. Vucinich.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 486-496, July, 1983. 5 Fig, 3 Tab, 40 Ref.

Descriptors: *Chub, *Fish food organisms, Fish management, Zooplankton, Invertebrates, Chironomids, Morphology, Pyramid Lake, Nevada.

The hypothesis that young of the year of two sympatric morphs of tui chub Gila bicolor were trophically indistinguishable was tested in Pyramid Lake, Nevada. Based on gill-raker counts, young-of-the-year tui chubs longer than 25 mm fork length could be separated into distinct morphs, G. b. obesa (fewer gill rakers) and G. b. pectinifer. Undesignated juveniles shorter than 26 mm, collected from depths 1 m and less, ate primarily zooplankton plus small quantities of macroinvertebrates. Among G. b. obesa, consumption of macroinvertebrates, principally chironomids, rose to 41% for fish 26-50 mm long and to 62% for fish 51-75 mm long. Among G. b. pectinifer, diets of fish 26-50 mm and 51-75 mm long contained 93 and 100% zooplankton, respectively. As young of the two morphs grew larger, their gill-raker distributions became nonoverlapping. Divergence in food selection accompanied the shift in numbers of gill rakers. The results suggest that sympatric morphological variants of polytypic fishes like tui chub should be treated as functionally distinct species for fishery-management considerations. (Author's abstract)
W84-02524

FEEDING ECOLOGY OF COEXISTING LARVAE OF AMERICAN SHAD AND BLUEBACK HERRING IN THE CONNECTICUT RIVER,
Connecticut Dept. of Environmental Protection, Hartford.
V. A. Crecco, and M. M. Blake.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 498-507, July, 1983. 2 Fig, 3 Tab, 58 Ref.

Descriptors: *Shad, *Herring, *Larvae, *Fish food organisms, *Connecticut River, Zooplankton, Competition, Predation.

Food-habit, niche-breadth, and diet-overlap analyses were conducted for larvae of American shad Alosa sapidissima and blueback herring Alosa aestivalis collected from the Connecticut River from June 3 to July 15, 1981. River zooplankton densities (number/cu m) were used to assess the influences of prey availability on niche-breadth and diet-overlap indices for the species. Niche-breadth values were consistently higher for blueback herring than for American shad larvae. American shad fed mostly on the less-abundant crustaceans and immature insects, whereas blueback herring larvae usually utilized the numerically dominant rotifers. The cladoceran Bosmina sp. was utilized extensively by American shad of all sizes and by 13-16-mm blueback herring larvae, and was the only prey for which interspecific competition between the larval predators might occur. The mean mouth gape of American shad larvae was always larger than that of blueback herring larvae at a given length, and American shad larvae of all sizes generally selected the larger cyclopoid copepodites and chronomid larvae. The diet-overlap indices varied over time, but were generally higher among length groups within species than between species, suggesting that intraspecific competition for food may be more severe than interspecific competition. (Author's abstract)
W84-02525

PISCIVOROUS FEEDING BEHAVIOUR OF LARGEMOUTH BASS: AN EXPERIMENTAL ANAYLSIS,
Kansas Univ., Lawrence. Dept. of Systematics and Ecology.
G. L. Howick, and W. J. O'Brien.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 508-516, July, 1983. 5 Fig, 4 Tab, 42 Ref.

Descriptors: *Bass, *Fish behavior, *Fish food, *Bluegill, Predation, Light intensity.

Largemouth bass Micropterus salmoides are the dominant top carnivores of many North American lakes and reservoirs and are very popular sport fish, but the actual behavioral mechanisms of their feeding are still poorly known. In laboratory experiments predation was broken into its component parts: location, pursuit, attach, and handling of prey. The distance at which largemouth bass can locate forage fish increases with prey size, with prey motion (when prey are small), and with light intensity. In the pursuit phase of the predation cycle, largemouth bass are more likely to choose prey with large apparent size, closer proximity, or greater motion. When bluegills Lepomis macrochirus were the experimental prey, the number of attempted attacks by largemouth bass before the prey was ingested increased with bluegill size, within broad limits. At high light intensities bluegills can locate modest-size largemouth bass (29 cm total length) long before the predators locate them, but at low light intensities, the advantage is reversed. (Author's abstract)
W84-02526

DISTRIBUTION AND GROWTH OF LARVAL RAINBOW SMELT IN EASTERN LAKE MICHIGAN, 1978-1981,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
H. T. Tin, and D. J. Jude.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 517-524, July, 1983. 3 Fig, 28 Ref.

Descriptors: *Smelt, *Larvae, *Distribution, *Growth, *Lake Michigan, Hatching, Water temperature, Seasonal variation, Water depth, Exotic fish.

Rainbow smelt is an introduced marine exotic with the potential for disrupting the Lake Michigan ecosystem. Distribution and growth of rainbow smelt Osmerus mordax larvae are described from samples collected in eastern Lake Michigan during 1978-1981 with plankton nets and benthic sleds deployed in water 1-15 m deep. This work was part of the investigations of fish populations in the vicinity of the J. H. Campbell electricity-generating plant located near Port Sheldon, Michigan. Rainbow smelt larvae less than 25.5 mm total length were caught from May to early August, whereas young of the year 25.5 mm and large occurred from July to September. Newly hatched larvae were found mostly during May; however, some hatching occurred in late June or early July, apparently due to slower incubation of eggs in deep cooler water. After hatching, rainbow smelt larvae were distributed in shallow water for a short period; from June to early August larvae were widely dispersed. Larvae concentrated inshore in late August. They generally were found at a few random depth strata from May to early August. In late August concentrated near bottom. Larval rainbow smelt were most common at water temperatures of 10 to 16 C. Rainbow smelt averaged from 5.3 to 6.1 mm in May; they grew to a mean length of 15.7 mm after 1 month and to 36.5-41.1 mm after 3 months. (Moore-IVI)
W84-02527

EFFECTS OF COMPLETE REDD DEWATERING ON SALMONID EGG-HATCHING SUCCESS AND DEVELOPMENT OF JUVENILES,
Idaho Cooperative Fishery Research Unit, Moscow.
For primary bibliographic entry see Field 6G.
W84-02528

RELATIVE SUSCEPTIBILITY OF FOUR STRAINS OF SUMMER STEELHEAD TO INFECTION BY CERATOMYXA SHASTA,
Oregon Dept. of Fish and Wildlife, Corvallis.
D. V. Buchanan, J. E. Sanders, J. L. Zinn, and J. L. Fryer.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 541-543, July, 1983. 1 Tab, 5 Ref.

Descriptors: *Salmon, *Ceratomyxa, *Columbia River, *Fish pathology, Parasites, Infection, Fish stocking.

All the summer steelheads Salmo gairdneri from the Siletz, an Oregon coastal river in which Ceratomyxa shasta does not occur, died when they were exposed to waters containing the infectious stage of C. shasta. In contrast, three strains of summer steelhead from tributaries of the Columbia River where C. shasta is endemic were resistant to ceratomyxosis. Salmonids from populations living in waters free of the infective stage of C. shasta should not be stocked in waters containing the pathogen. Columbia River summer steelheads are exposed to the infectious stage of C. shasta both as smolts emigrating in the spring and as adults ascending the Columbia River during the summer. The historical exposure has resulted in resistance to C. shasta probably through the process of natural selection. (Moore-IVI)
W84-02529

EXPERIMENTAL TESTS OF OPTIMAL HABITAT USE IN FISH: THE ROLE OF RELATIVE HABITAT PROFITABILITY,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
E. E. Werner, G. G. Mittelbach, D. J. Hall, and J. F. Gilliam.
Ecology, Vol. 64, No. 6, p 1525-1539, 1983. 9 Fig, 3 Tab, 30 Ref, 1 Append. NSF grants DEB-7824271, DEB-8119258, and DEB-8104697.

Descriptors: *Bluegills, *Fish food, *Aquatic habitats, *Model studies, Predation, Daphnia, Midges, Prediction, Fish behavior, Habitats, Feeding.

Animals generally exhibit considerable selection in the foods they consume and the habitats they use, and these choices are considered to be important to their relative fitness. Optimal foraging theory and laboratory estimates of foraging costs were used to predict the choice of foods and use of habitats by fish in the field. These predictions are tested with the bluegill sunfish (Lepomis macrochirus) foraging in three habitats (open water, sediments, and vegetation) in a pond. Relations describing prey encounter rates in each habitat as a function of prey size, prey density and fish size were derived from laboratory experiments. These relations were used to estimate prey encounter rates based on weekly prey samples in each habitat of the pond. The optimal diet and profitability (net energy return) were determined for each habitat through time. Predictions of optimal diet exhibited good qualitative correspondence to the actual diet of the fish in the open water and vegetation, although a slightly narrower diet consistently predicted than the fish were choosing. The model correctly predicted the magnitude of the change in size selection on Daphnia pulex with fish size and with decline in prey density. Predictions of optimal diet in the sediments were considerably in error apparently due to a tendency for late-instar midges to burrow deep in the sediments, thereby becoming unavailable to the fish. In this case habitat profitabilities were computed simply on the basis of the actual observed diet. Predictions of optimal habitat use showed striking correspondence to the actual habitat use of the fish; the bluegills switched from feeding in the open water column to feeding from the sediments within a few days of the predictions. The actual habitat use pattern differs dramatically from a null model of random habitat use. This approach may be useful in studying intra- and interspecific exploitative interactions. (Moore-IVI)
W84-02542

PREDATOR-PREY INTERACTIONS AND BREEDING-POND USE OF TEMPORARY-POND SPECIES IN A DESERT ANURAN COMMUNITY,
New Mexico Univ., Albuquerque. Dept. of Biology.
B. D. Woodward.
Ecology, Vol. 64, No. 6, p 1549-1555, 1983. 1 Fig, 4 Tab, 32 Ref.

Descriptors: *Tadpoles, *Temporary ponds, *Predation, *Ponds, Chihuahuan Desert, New Mexico, Anura, Reproduction, Behavior.

Several anuran species in central New Mexico have access to both permanent and temporary ponds yet typically use only one or the other pond type. Six anuran species were studied in the Chihuahuan Desert in Soccoro County, central New Mexico. From 1 August to 3 September 1978, 16 temporary and 17 permanent ponds were sampled during midday to determine relative predator densities. Predators found only at night were very uncommon and were estimated by counting tracks around ponds. More individual terrestrial predators, more terrestrial predator species, and more individual aquatic predators per cubic meter exist in permanent than in temporary ponds, suggesting that predators may prevent temporary-pond species from using permanent ponds. Eight predator species consumed more temporary- than permanent- pond tadpoles in 17 of 20 pairwise choice experiments. Temporary-pond tadpoles, were almost continually in motion, while permanent-pond tadpoles were almost always stationary. This differential movement may account for the vulnerability of temporary-pond tadpoles to predation. The nonrandom distribution of predators in this tadpole community and the inability of some tadpoles to avoid predation apparently restricts some anurans to temporary ponds. (Moore-IVI)
W84-02543

SPATIAL AND TEMPORAL DISTRIBUTION OF BENTHIC DIATOMS IN NORTHERN LAKE MICHIGAN,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. C. Kingston, R. L. Lowe, E. F. Stoermer, and T. B. Ladewski.
Ecology, Vol. 64, No. 6, p 1566-1580, 1983. 11 Fig, 2 Tab, 64 Ref. NSF grant OCE 77-21854.

Descriptors: *Diatoms, *Spatial distribution, *Temporal distribution, *Lake Michigan, *Benthos, Plankton, Overwintering, Species diversity, Seasonal variation.

Benthic diatom communities were sampled from natural substrates along a depth transect in northern Lake Michigan to examine spatial and seasonal distribution patterns and define assemblages of associated taxa. Information-theory diversity, evenness, and richness were significantly higher in deep assemblages than in shallow assemblages, with the boundary falling between 5 and 10 m in winter and fall, 10 and 20 m in spring, and 20 and 31 m in summer. Planktonic taxa are abundant on benthic substrates in the deep zone, primarily as dead fallout. In shallow water, large numbers of living planktonic taxa overwinter beneath the ice on benthic substrates. Cluster analysis of samples was used to identify and define diatom assemblages from deep, mid-depth, and shallow water. The deepwater assemblage contains motile and nonmotile benthic species that have been reported from alpine and boreal oligotrophic lakes. The mid-depth assemblage is rich in epipsammic taxa. The shallow-water assemblages contain cosmopolitan taxa that are collected often in nearshore plankton samples. These shallow assemblages do not persist throughout the year as do the deep and mid-depth assemblages. Cluster analysis of taxa provides further definition of species associations and the degree of correlation among species. Correlations among benthic taxa are strengthened when planktonic taxa are removed from the analysis, indicating that plankton fallout represents an addition of information which is poorly related to distribution of the benthic species. The most stable and diverse community is found at the deepest sampling depths where environmental conditions are most stable, the mid-depth community exists in fluctuating but predictable conditions, and the shallow assemblages occur in the zone of maximum physical fluctuation or natural stress. Substrate types are correlated with the species assemblages, but the high diversity of substrate types in shallow water does not support the most diverse assemblage. The discrete species assemblages seen in an oligotrophic area of this large dimictic lake apparently respond sensitively to temporally and spatially dynamic environmental parameters. (Author's abstract)
W84-02544

AUTOTROPHIC PROCESSES IN MEROMICTIC BIG SODA LAKE, NEVADA,
Geological Survey, Menlo Park, CA.
J. E. Cloern, B. E. Cole, and R. S. Oremland.
Limnology and Oceanography, Vol. 28, No. 6, p 1049-1061, November, 1983. 4 Fig, 3 Tab, 46 Ref.

Descriptors: *Autotrophic processes, *Big Soda Lake, *Nevada, *Photosynthesis, *Chemoautotrophy, *Productivity, Phytoplankton, Purple sulfur bacteria, Meromictic lakes, Saline lakes, Seasonal variation, Thermal stratification, Bacteria.

Daily rates of oxygenic photosynthesis (OP) by phytoplankton, anoxygenic photosynthesis (AP) by purple sulfur bacteria, and chemoautotrophic productivity (CP = dark CO2 assimilation) were measured once each season in saline, meromictic Big Soda Lake. Total daily productivity and the relative importance of each autotrophic process varied with seasonal changes in vertical mixing, light availability, and the biomass of phototrophs. Daily productivity was highest (2,830 mg C/sq m) and was dominated by OP in winter when the mixolimnion was isothermal, the biomass of phytoplankton was high, and the biomass of purple sulfur bacteria was low. During the summer-fall period of thermal stratification, phytoplankton biomass decreased, a plate of purple sulfur bacteria formed below the oxycline, and the daily rates of dark CO2 assimilation (CP = 390-680 mg C/sq m) exceeded phototrophic productivity (OP + AP = 200-370 mg C/sq m). Total annual productivity was about 500 g C/sq m, of which 60% was produced by phytoplankton (mostly in winter), 30% by chemoautotrophs (nitrifying and sulfuroxidizing bacteria), and only 10% by photosynthetic bacteria. (Author's abstract)
W84-02545

CARBOXYLATING ENZYME ACTIVITY AND PHOTOSYNTHETIC END PRODUCTS OF PHYTOPLANKTON IN THE SHALLOW AND DEEP CHLOROPHYLL LAYERS OF CASTLE LAKE,
California Univ., Davis. Div. of Environmental Studies.
J. C. Priscu, and C. R. Goldman.
Limnology and Oceanography, Vol. 28, No. 6, p 1168-1181, November, 1983. 4 Fig, 2 Tab, 49 Ref. NSF grant DEB80-19918 and DEB76-19524.

Descriptors: *Phytoplankton, *Photosynthesis, *Castle Lake, *California, Enzyme activity, Carbon metabolism, Water temperature, Light, Nitrogen, Algae.

The patterns of carbon assimilation of the Castle Lake (California) phytoplankton were measured under various environmental conditions. The flow of carbon into polysaccharides and lipids plus low molecular weight metabolites was generally highest at low temperatures and low light (i.e. under-ice and deep-water populations). Enrichment with nitrogen to nitrogen-deficient algae did not significantly alter the patterns of carbon assimilation during time-series experiments. However, the relative rates of polysaccharide and protein synthesis were increased when the entire epilimnion of the lake was fertilized with nitrogen. On the average about 15% more carbon could potentially be fixed by the anaplerotic enzyme phosphoenolpyruvate carboxylase (PEPCase) than the Calvin Cycle enzyme ribulose-1,5-biphosphate carboxylase (RuBPCase). The parameter, RuBPCase : PEPCase/photon saturated in vivo photosynthesis (Pmax), was consistently > 1.0 liter/h/microgram C and showed significant differences between the 3-m and 20-m algal populations, indicating that they may be physiologically distinct with respect to carbon metabolism. The proportion of C14 incorporated into protein increased as the ratio of RuBPCase to PEPCase increased. The converse was true for the relative sythesis of lipid + low molecular weight (LMW) compounds while the proportion of C14 incorporated into polysaccharide varied little with RuBPCase: PEPCase. These findings and others from the literature do not corroborate existing simple biochemical models for this relationship, implying that other carboxylating enzymes may be important in the carbon metabolism of certain algae. (Author's abstract)
W84-02546

BIOCHEMICAL CONSTITUENTS OF PARTICULATE MATTER IN A MESOTROPHIC IRRIGATION POND,
National Inst. for Environmental Studies, Tsukuba (Japan).
A. Otsuki, T. Miyoshi, T. Unno, and H. Seki.
Archiv fur Hydrobiolgie, Vol. 98, No. 1, p 1-14, September, 1983. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Particulate matter, *Irrigation ponds, *Organic compounds, Amino acids, Fatty acids, Carbohydrates, Mesotrophic lakes, Seasonal variation, Organic matter, Shin-ike Pond, Japan.

Particulate organic matter was sampled in Shin-ike Pond, a representative mesotrophic freshwater pond. The concentrations of particulate organic carbon, particulate amino acids, and particulate fatty acids showed obvious seasonal fluctuations. The concentration started to increase at the beginning of spring up to a moderate level, and was maintained during the spring in a steady state oscillation. The levels further increased drastically at the start of summer and reached maximum levels in August. Concentrations fell rapidly to a moderate level in mid autumn. Levels of organic carbon, amino acids and carbohydrates decreased gradually during winter and reached minimum for the year at the end of winter. The concentration of particulate fatty acids showed a steady-state oscillation during autumn as during spring, and began to decrease at the beginning of winter. Amino acids were the major group, composed chiefly of glutamic acid, aspartic acid, leucine, alanine, glycine, threonine, serine, valine, lysine, phenylalanine, proline, arginine, isoleucine, tyrosine, histidine, and methionine. (Baker-IVI)
W84-02547

POPULATION DYNAMICS OF CAULOBACTERS IN A MESOTROPHIC IRRIGATION POND,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Ezura, and H. Seki.
Archiv fur Hydrobiolgie, Vol. 98, No. 1, p 15-38, September, 1983. 14 Fig, 20 Ref.

Descriptors: *Population dynamics, *Irrigation ponds, *Caulobacter, Bacteria, Shin-ike Pond, Japan, Seasonal variations, Water temperature, Temperature effects, Mesotrophic lakes, Nitrates, Ammonia, Phosphates, Irrigation water.

Population dynamics of caulobacters were studied in Shin-ike Pond, which is a typical freshwater irrigation pond in Japan. The water in the pond should be categorized as mesotrophic. Heterotrophic bacteria belonging to the genera Caulobacter and Asticcacaulis were a component of the bacterioplankton community. These caulobacters appeared as bacterial pulses in the pond during all seasons of the year. The duration of each pulse was as long as three months in autumn and as short as one month in winter. A pulse of the stalk formation stage of caulobacters was observed in the pond as leading to a following pulse of community growth with a certain time lag. This time lag was shorter in winter and longer in summer. The longer time lag during summer was due partly to the influence of the phytoplankton bloom. Another reason for this longer time lag may be due to active zooplankton grazing of stalked caulobacters during summer when planktonic crustaceans are abundant. The population dyanmics are controlled by organic nutrients dissolved in the pond as the limiting factor. This was clearly shown by the dissolved organic carbon growth relationship expressed as a highly significant regression curve. Water temperature was regarded as a non-limiting factor but had a profound effect on the community growth of caulobacters by modifying biological processes. (Baker-IVI)
W84-02548

THE GRAM-STAIN CHARACTERISTICS OF THE BACTERIAL COMMUNITY AS A FUNCTION OF THE DYNAMICS OF ORGANIC DEBRIS IN A MESOTROPHIC IRRIGATION POND,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
H. Kang, and H. Seki.
Archiv fur Hydrobiolgie, Vol. 98, No. 1, p 39-58, September, 1983. 20 Fig, 19 Ref. Japanese Ministry of Education grant 57480004.

Descriptors: *Population dynamics, *Irrigation ponds, *Bacteria, Shin-ike Pond, Japan, Seasonal variations, Water temperature, Temperature effects, Mesotrophic lakes, Irrigation water, Plankton.

Shin-ike Pond is a shallow freshwater irrigation pond, typical in Japan, located on the northern slope of the small mountain, Shiroyama in Tsukuba District, Ibaraki Prefecture, Japan. Water samples were collected from the pond twice a week, from 6 March 1981 to February 1982, at depths of 0, 50 and 100 cm. The percentage of gram-negative forms in the bacterial communities of Shin-ike Pond fluctuated seasonally. Maximal percentages of gram-negative bacterioplankton were noted in March, June, November and February, and minima in May, August and December. Attached bacteria showed maxima in March, May, July, November and February, and minima in April, June, August, and December. A considerable fraction of the bacterioplankton community in the pond was gram-negative at any season. Utilization of dissolved organic materials by gram-negative bacteria was directly related to the availability of organic materials from phytoplankton. Such organic solutes were assimilated readily as soon as they were excreted by the phytoplankton. (Baker-IVI)
W84-02549

NUTRIENT UPTAKE BY PHYTOPLANKTON IN A MESOTROPHIC IRRIATION POND IN JAPAN,
Tokyo Univ. (Japan). Ocean Research Inst.
Y.-I. Nakamura, T. Hirano, Y. Hara, and H. Seki.
Archiv fur Hydrobiolgie, Vol. 98, No. 1, p 59-69, September, 1983. 6 Fig, 22 Ref. Japanese Ministry of Education grant 574800004.

Descriptors: *Nutrients, *Mesotrophic lakes, *Irrigation ponds, Phytoplankton, Japan, Shin-ike Pond, Irrigation water, Ponds, Chlorophyll, Nitrogen, Metabolism.

The seasonal variation of chlorophyll concentration in Shin-ike Pond showed that different species of phytoplankters seem to have appeared alternately in moderately high densities and to have bloomed in spring, summer and autumn. No bloom was noted during the winter months. The predominant species of the chlorophyll-b group in these phytoplankters were Crucigenia tetrapedia, Scenedesmus quadricauda, S. acuminantus, Scenedesmus sp., Euglena gigas, Euglena sp., Trachelomonas oblonga, Trachelomonas sp., and those of the chlorophyll-c group were Synedra, Mallomonas, Chromulina, Chrysococcus, Kephyrion, Peridinium, Gonyostomum semen, and Cryptomonas species. The standing stock could be expressed as a hyperbola relative to the inorganic nitrogen. That is, the threshold concentration for the uptake of inorganic nitrogen was between 1/4 and 1/2 of that needed to maintain the steady state population density in the pond. On the other hand, the nutrient uptake system of chlorophyll-b containing organisms was not active. The concentration of inorganic nitrogen was always high, between 9 and 30 micrograms N per liter, when they were predominant. (Baker-IVI)
W84-02550

TRANSIENT MEROMIXIS AND RELATED CHANGES OF EUTROPHICATION PARAMETERS IN A SMALL POLYTROPHIC LAKE IN SOUTHWEST GERMANY,
Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Biologie.
V. Kracht.
Archiv fur Hydrobiologie, Vol. 98, No. 1, p 93-114, September, 1983. 16 Fig, 6 Tab, 50 Ref.

Descriptors: *Eutrophication, *Lake Stadtsee, *Cyanophyta, *Meromixis, Nutrient cycling, Phytoplankton, Nitrogen, Phosphorus, Oscillatoria, Climate.

For several hundred years Lake Stadtsee has been polluted by sewage loading from the surrounding city Bad Waldsee. In the last decades the lake showed polytrophic conditions with annual blue-green algal blooms. Nutrient cycles and development of phytoplankton in Lake Stadtsee were studied from March 1980 to March 1982. During an extreme bloom of Oscillatoria Redekei during thermal stratification in summer 1980, inorganic nitrogen, phosphate and other eutrophication-indicating substances of the epilimnetic layer were largely depleted. The enrichment of these substances was measured in the anaerobic hypolimnion. In spring 1981 the usually dimictic Lake Stadtsee showed a meromixis, and the internal loading of the trophogenic zone was suspended. The transient meromixis in March 1981 was only a temporary event, and should be called transient partial circulation. Extraordinary climatic conditions were responsible for this event. Phytoplankton biomass the following summer was reduced to less than 0.5% of the values for 1980. The amount of blue-green algae decreased completely after springtime. While extraordinary enrichment of nutrients could be measured in the hypolimnion, the epilimnetic content of inorganic nitrogen and phosphate was also higher than the year before, resulting from the reduced demand by phytoplankton. The reduced development of algae is interpreted as a result of the suspended internal nutrient cycle. (Moore-IVI)
W84-02551

LONG-TERM POPULATION DYNAMICS AND PRODUCTION OF PISIDIUM (BIVALVIA) IN THE PROFUNDAL OF LAKE ESROM, DENMARK,
Joensuu Univ. (Finland). Dept. of Biology.
I. J. Holopainen, and P. M. Jonasson.
Oikos, Vol. 41, No. 1, p 99-117, 1983. 18 Fig, 6 Tab, 65 Ref.

Descriptors: *Pisidium, *Mollusks, *Population dynamics, *Lake Esrom, *Denmark, Eutrophic lakes, Reproduction, Dissolved oxygen, Hypolimnion, Growth, Water temperature, Mortality.

During the 21 years (1953-1973, 1976-1977) of routine quantitative sampling reported in this paper, three species of Pisidium (P. casertanum, P. substruncatum and P. henslowanum) have been present in the profundal of the eutrophic Lake Estrom, Denmark. From 1955 to 1962 P. casertanum was numerically dominant (peak density of 3273 ind/sq m was attained in 1957), at other times P. substrucatum dominated (peak 3025 ind/sq m in 1955). Since 1957-1958 the densities of both species have been below 1000 ind/sq m. The peak density of P. henslowanum (370 ind/sq m) was attained in 1957. All the species laid their eggs in spring (April-May), but the young were not released until the following winter, the exact time depending on the temperature and oxygen conditions. Only some of the eggs laid developed into young, and the size of the brood was dependent on parental size. The young reached maturity at the age of 2 yr, and a maximum life-span of 4-5 yr is suggested. The regularly occurring oxygen deficiency in the hypolimnion in summer caused heavy mortality in the dominant species and halted growth of individuals. Both the standing crop and annual production were lower in the population of P. subtruncatum, which is a smaller species. The annual P/B-ratios were ca. 1 in both the dominant populations. (Author's abstract)
W84-02554

THE ROLE OF FLAGELLATED PHYTOPLANKTON IN CHAINS OF SMALL BROWN-WATER LAKES IN SOUTHERN FINLAND,
Maj and Tor Nessling Foundation, Helsinki (Finland).
V. Ilmavirta.
Annales Botanici Fennici, Vol. 20, No. 2, p 187-195, 1983. 7 Fig, 4 Tab, 13 Ref.

Descriptors: *Flagellates, *Phytoplankton, *Chain lakes, *Finland, Color, Oligotrophic lakes, Mesoeutrophic lakes, Cryptomonads, Chrysomonads, Biomass, Solar radiation.

Small forest lakes are an important part of the Finnish environment. Typical of many forest lakes is brown water color, a relatively low pH, a shallow epilimnion and photosynthetic layer, and frequent oxygen depletion in the hypolimnion. These lakes often form chains, the water running from lake to lake. The biomass and species composition of the phytoplankton were studied together with some chemical parameters in 32 brown-water lakes in southern Finland, during three open-water periods. The waters form four lake chains, and the results are presented as the means of the chains. Of the lake chains, two are meso-eutrophic, two oligotrophic. Flagellated species made important contributions to the biomass in two of the brown-water chains, where cryptomonads and chrysomonads predominated. Flagellates compose more than 50% of the biomass when the color of the water is more than 50 mg Pt/l. Light seems to be the major factor regulating productivity. The high phytoplankton productivity in extremely oligotrophic brown lakes may be due to the migration of flagellates through the thermocline to take up additional nutrients from the hypolimnion and migration back to the illuminated layer for assimilation. (Moore-IVI)
W84-02610

SUBMERSED MACROPHYTE VEGETATION AND DEPTH DISTRIBUTION IN CHENANGO LAKE, NEW YORK,
State Univ. of New York at Binghamton. Dept. of Biological Sciences.
J. E. Titus.
Bulletin of the Torrey Botanical Club, Vol. 110, No. 2, p 176-183, April-June, 1983. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Aquatic plants, *Water depth, *Chenango Lake, *New York, *Macrophytes, Littoral zone, Vegetation, Submerged plants, Depth distribution.

Sixteen submersed taxa occurred in 900 0.15 sq m sample plots in Chenango Lake, a small (12.2 ha), shallow (mean depth = 1.76 m), alkaline lake. The most frequently encountered species were Chara vulgaris L. (73.1% frequency), Vallisneria americana Michx. (47.7%), and Potamogeton amplifolius Tuckerm, (38.8%). Other species with a frequency greater than 20% were Elodea canadensis Michx., Myriophyllum exalbescens Fern., and P. praelongus L. A vegetation map derived from transect data demonstrated that ca. 35% of the littoral zone sampled was dominated by Chara vulgaris, ca. 29% by Vallisneria americana, and ca. 21% by P. amplifolius. An unusual pattern of alternating bands of C. vulgaris and V. americana with increasing depth was observed. Considerable overlap exists in the depth ranges of the six most frequent species, but these species do differ significantly in the overall patterns of their depth distributions according to pairwise chi-square tests. Vallisneria americana showed its highest frequencies from 0.5-2.5 m, Chara vulgaris from 1-6 m, Elodea canadensis from 1-5 m, Potamogeton amplifolius from 1.5-5.5 m, Myriophyllum exalbescens from 2-5 m, and P. praelongus from 2-5.5 m. Chara vulgaris was significantly positively associated with all of the other most frequent species except Vallisneria americana. Potamogeton praelongus also registered positive associations with P. amplifolius and Myriophyllum exalbescens. In contrast, Vallisneria was negatively associated with both P. praelongus and M. exalbescens. The biological basis for observed distribution patterns is not yet known. (Author's abstract)
W84-02621

COMPLEXATION OF COPPER OF AQUATIC HUMIC MATTER STUDIED BY REVERSED-PHASE LIQUID CHROMATOGRAPHY AND ATOMIC ABSORPTION SPECTROSCOPY,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
G. Becher, G. Oestvold, P. Paus, and H. M. Seip.
Chemosphere, Vol. 12, No. 9, p 1209-1215, 1983. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Copper, *Natural waters, *Speciation, Humic acids, Decomposing organic matter, Atomic absorption spectroscopy, Metals, Complexation, Ions, Polarity, Geochemistry.

A combination of reversed-phase liquid chromatography and flameless atomic spectroscopy was used to study the speciation of copper in water containing natural organic compounds. The major part of the metal is found as ionic or highly polar complexes, but significant amounts are also found in fractions containing less polar compounds. In spite of certain limitations the method should be useful as a supplement to other techniques for studying metal complexation in natural waters. Humus water collected from Hellerudmyra near Oslo, Norway, was filtered and concentrated. The concentration of Cu in the final sample was adjusted to 2.6 ppm. Samples from Lake Ringvatnet near Trondheim, Norway were obtained from 1 m depth. (Baker-IVI)
W84-02631

PARTICULATE FLUX AT THE BOTTOM OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
F. Rosa, J. O. Nriagu, and H. K. Wong.
Chemosphere, Vol. 12, No. 9/10, p 1345-1354, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Lake Ontario, *Particulates, *Lake sediments, Resuspension, Samplers, Water currents, Organic matter, Degradation, Trace metals, Fate of pollutants.

A special resuspension sediment sampler (RSS) was built and installed at an offshore station in the Western Basin of Lake Ontario during the summer

of 1981. The RSS carried an array of cylindrical traps at seven depths varying from 0.2 to 7 m above the sediment-water interface. Time-series sediment traps deployed at closely spaced intervals near the bottom of Lake Ontario show that the amount of material collected decreases exponentially with increasing distance from the sediments. At heights of 0.2 and 7 m above the bottom about 85% and 45% respectively of the suspended tripton is recruited from the sediments. The upward flux of particles is strongly correlated with speed of bottom currents, and the turn-over rate for particles at the sediment-water interface is estimated to be only a few hours. Near the bottom of Lake Ontario, the downward flux of particulate matter is small compared to the rate of sediment resuspension. The intense resuspension of sediments apparently affects the zone. A large fraction of the organic matter falling through the water column is degraded in the bottom waters containing the resuspended sediments. The constant resuspension of sediments should also play an important role in the removal of pollutant metals from the water column. The resuspension process can resolve a number of puzzling features pertaining to the distribution of pollutant metals in the Great Lakes sediments, including the movement of sediment-bound pollutants, the mixing layer, and the variability in the trace metal profiles in Great Lakes sediments. (Moore-IVI)
W84-02633

AN IMPROVED TECHNIQUE FOR ESTIMATING MEAN DEPTH OF LAKES,
Corvallis Environmental Research Lab., OR.
J. M. Omernik, and A. J. Kinney.
Water Research, Vol. 17, No. 11, p 1603-1607, 1983. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Lakes, *Water depth, Planimetry, Dot grid method, Measurment methods, Lake morphometry, Mapping, Bathimetry.

A technique is described for determining mean lake depth utilizing a systematically aligned dot grid. The dot grid pattern is placed over the bathymetric lake map, and the depth corresponding to each dot falling within the shoreline of the lake was estimated by visually interpolating between the contour lines. The depth readings were recorded, summed, and the total divided by the number of dot readings recorded to obtain the mean depth of the lake. Differences in map scale, and lake size and complexity, necessitate the use of different dot grid spacings. The technique is, on average, 55% faster than the traditional planimeter methods. No detectable bias is associated with results from this technique compared with those of traditional planimeter methods. The dot grid technique requires a relatively routine arithmetic process and no mechanical devices. Factors affecting the utility of the dot grid for estimating mean depth are: the user's ability to interpolate values; contour interval; and map scale. Map scale should be consistent with lake size; but, in general the larger the map scale the greater the level of detail represented, hence the greater the utility of the dot planimeter. (Moore-IVI)
W84-02707

RELATIONSHIP OF MATERIALS IN FLOODED SOILS AND SEDIMENTS TO THE WATER QUALITY OF RESERVOIRS-I; OXYGEN CONSUMPTION RATES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. Gunnison, R. L. Chen, and J. M. Brannon.
Water Research, Vol. 17, No. 11, p 1609-1617, 1983. 3 Fig, 6 Tab, 28 Ref.

Descriptors: *Reservoirs, *Sediments, *Flooded soils, *Oxygen consumption, Microorganisms, Aquatic sediments, Leaching, Degradation, Temperature effects.

Oxygen consumption rates were obtained for four soils and six reservoir sediments using sediment-water reaction chambers and a differential respirometer. Determination of microbial activity as measured by (C-14)glucose metabolism was also performed on these soils and sediments. To study the transformation of newly flooded soils into aquatic sediments, the effects of prolonged submergence and temperature upon oxygen consumption, carbon dioxide formation and methanogenesis were examined. Newly flooded soils initially had high biological oxygen consumption rates, ranging from 67.2 to 76.6% of the total oxygen demand. Established reservoir sediments, in contrast, exhibited extremely high chemical oxygen demands, ranging from 62.7 to 89.9% of the total oxygen demand and had proportionately lower biological oxygen demands. Newly flooded soils had the capacity for high rates of oxygen consumption, carbon dioxide formation, and methanogenesis. These rates were extremely temperature-dependent and subject to rapid decline with prolonged submergence due to leaching and degradation of biologically available organic carbon (BAOC). With aging, the amount of BAOC released from the flooded soils decreased, the proportion of reduced inorganic chemical species increased, and a distinct aerobic-anaerobic double layer developed at the soil surface during aerobic conditions in the overlying water column. In reservoirs, the process is complicated by reservoir hydrodynamics and morphometric properties which tend to move waters of poor quality out of the system with subsequent downstream effects. (Moore-IVI)
W84-02708

COMPARISONS OF TROPHIC STATE MEASUREMENTS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
V. W. Lambou, W. D. Taylor, S. C. Hern, and L. R. Williams.
Water Research, Vol. 17, No. 11, p 1619-1626, 1983. 4 Tab, 34 Ref.

Descriptors: *Lakes, *Trophic level, *Phosphorus, *Chlorophyll a, Nutrients, Eutrophication, Secchi disks, Kjeldahl nitrogen, Phytoplankton, Algae.

Twenty-nine methods commonly used to measure trophic state were compared with respect to their ability to rank 44 test lakes against two standards: total phosphorus, a nutrient or driving force standard and chlorophyll a, an eutrophication response standard. The phosphorus loading models had high rank correlations with phosphorus; however, they did not rank the lakes well against chlorophyll. The relative trophic ranking of many lakes differed depending upon whether primary nutrients or biological manifestations were used as the ranking mechanism. Secchi disk was very effective in ranking the lakes against phosphorus but was relatively ineffective in ranking them against chlorophyll. Total Kjeldahl nitrogen was effective in ranking the lakes against phosphorus and had the highest rank correlation of all the methods tested against chlorophyll. Methods based upon phytoplankton community structure were especially ineffective in ranking the test lakes. Algal assay control yield gave disappointing results when compared against the chlorophyll standard. Most methods were much more effective in ranking the lakes against the total phosphorus standard than the chlorophyll a standard. (Author's abstract)
W84-02709

INDIAN CREEK RESERVOIR SEDIMENTS,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
V. D. Adams, M. L. Cleave, J. R. Cofer, and E. J. Middlebrooks.
Water Research, Vol. 17, No. 11, p 1709-1712, 1983. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Reservoirs, *Sediments, *Indian Creek Reservoir, *Effluents, Advanced wastewater treatment, Eutrophic lakes, Phosphorus, Carbon, Nitrogen, Chlorophyll.

Indian Creek Reservoir (ICR) was originally designed to hold the effluent from the South Tahoe Public Utility District (STPUD) advanced wastewater treatment plant during the winter months and to release the impounded water during the irrigation season. The original use of the reservoir has been modified extensively, and in addition to the agricultural uses, the reservoir has become a popular recreational facility. Changes in the use of the reservoir have resulted in changes in the standards imposed upon the STPUD and ICR. Because of the unique nature of the influent to ICR, unusual claims are frequently made about the characteristics of the water and sediments. The question is frequently asked if the sediments in ICR differ from those found in other eutrophic lakes or reservoirs. Sediment samples were collected from four diverse sites in the reservoir. The samples were analysed for phosphorus, carbon, nitrogen, volatile content, and chlorophyll content. The results of the analyses showed that the sediments are typical of those found in any eutrophic lake or reservoir. (Author's abstract)
W84-02715

THE DYNAMICS OF SUSPENDED ALGAL POPULATIONS IN THE LOWER WYE CATCHMENT,
Welsh Water Authority, Powys (Wales).
F. H. Jones.
Water Research, Vol. 18, No. 1, p 25-35, 1984. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Algae, *Population dynamics, *Lugg, *Wye, England, Solar radiation, River flow, Scenedesmus, Cyclotella, Filter feeders, Water treatment, Taste, Odor, Deoxygenation, Haloforms.

The algae of the River Wye and its tributary the River Lugg were described principally from samples collected from 7 sites in the lower Wye catchment during 1980 and 1981. The density of algae in the Wye was found to be correlated with river flow and solar radiation, highest numbers (1,250,000 cells/ml), principally of Scenedesmus and Cyclotella, occurring at low stable flows and relatively high solar radiation. Algal populations in the Lugg were much smaller (<1,300 cells/ml) than those of the Wye and were principally composed of species derived from the periphyton. Downstream increases in load (cell density x flow) of both Scenedesmus and Cyclotella in the Wye were generally equivalent to about 0.3 division/d; these rates were lower than those obtained in laboratory culture and this was probably largely related to underestimates arising from algal removal by filter feeders (principally simuliid larvae). Potential problems arising from the treatment of Wye water supporting substantial algal growths are considered; these include haloform production, deoxygenation in a transfer pipeline, algal penetration into potable supply and taste and odor. (Author's abstract)
W84-02738

THE INTERACTION OF LAKES WITH VARIABLY SATURATED POROUS MEDIA,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W84-02764

THE ROLE OF BENTHIC MACROINVERTEBRATES IN DETRITUS DYNAMICS OF STREAMS: A COMPUTER SIMULATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. R. Webster.
Ecological Monographs, Vol. 53, No. 4, p 383-404, December, 1983. 13 Fig, 5 Tab, 112 Ref.

Descriptors: *Invertebrates, *Detritus, *Simulation, *Computer models, Stream dynamics, Stream order, Particulates, Organic matter, Storms, Big Hurricane Branch, North Carolina.

Detritus dynamics in Big Hurricane Branch, a second-order stream at Coweeta Hydrologic Laboratory (North Carolina) in the southern Appalachian Mountains, were simulated with a computer model, using data from a variety of Coweeta stream studies. The model was used to evaluate the role of macroinvertebrates in the stream. Macroinvertebrates accounted for only a small portion of the respiration of detritus; their major role was conversion of benthic detritus into transported detritus. Macroinvertebrates were responsible for

27% of annual particulate organic matter (POM) transport, though when they were removed there was only a 10% reduction in POM transport because of a compensatory increase in storm transport. The contribution of macroinvertebrates to POM transport during nonstorm periods was much more significant, as high as 83% in late summer. Based on an annual budget, macroinvertebrates decrease the efficiency of detritus processing in low-order streams, because they increase transport loss. On a longer time scale, however, macroinvertebrates prevent accumulation of large amounts of detritus in the stream and major losses during infrequent large storms. By stabilizing long-term detritus export dynamics, they provide an important link between low-order and higher-order streams. (Author's abstract)
W84-02776

VARIABILITY OF WATER TEMPERATURES IN THE BRAIDED ASHLEY AND RAKAIA RIVERS,
Ministry of Works and Development, Christchurch (New Zealand).Water and Soil Science Centre.
M. P. Mosley.
New Zealand Journal of Marine and Freshwater Research, Vol. 17, No. 3, p 331-343, 1983. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Water temperature, *Ashley River, *Rakaia River, *New Zealand, Braided rivers, Seasonal variation, Groundwater, Underflow seepage, Fish.

Water temperatures were measured throughout the day in selected branch channels of the Ashley and Rakaia Rivers, on days near midwinter, midsummer, and the equinox. At any 1 time, water temperatures in the channels varied over several degrees; the maximum range observed was between 17.2 and 35 C in the Ashley River at 1400 h in December 1982. Without interchange with groundwater, rate of downstream increase in temperature is theoretically proportional to phi sub net, the net heat exchange at the water surface, and Q(-0.067), where Q is discharge, so that smaller channels should have a greater rate of temperature increase (and therefore, higher temperatures) than larger channels. However, it was commonly observed that small channels had lower temperatures than the main channel, because of the seepage of cool underflow from the streambed. Up to 40% of the total water surface area may have temperatures several degrees cooler than the main channel; this may represent potential refuges for fish for which the high temperatures elsewhere would be lethal. (Author's abstract)
W84-02838

STUDIES ON THE DETERMINATION OF DISSOLVED OXYGEN IN WATER,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
M. Malaiyandi, and V. S. Sastri.
Talanta, Vol. 30, No. 12, p 983-985, 1983. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Dissolved oxygen, *Chemical properties, Anions, Ethylenediaminetetra-acetate, Cyclohexanediaminetetra-acetate, Oxygen balance.

Studies on the decomposition rates of the Mn(III) complex of cyclohexanediaminetetra-acetate (DCTA) in light and in darkness show that this complex is more stable than the one derived from ethylenediaminetetra-acetate. The optimum pH range for the determination of dissolved oxygen by means of the Mn(III)-DCTA complex is between 3 and 4. The absorbance of this complex is independent of the amount of DCTA used (in the range 0.2-1.0 g) with water samples containing a maximum of 3.2 ppm of dissolved oxygen. Significant interferences are caused by the presence of anions at 500 times the oxygen concentration. (Murphy-IVI)
W84-02912

SENSITIVITY OF LAKES TO INORGANIC ENRICHMENT STRESS - SOME RESULTS OF EXPERIMENTALLY INDUCED FERTILIZATION,
Polish Academy of Sciences, Warsaw.
A. Hillbricht-Ilkowska, and B. Zdanowski.
Internationale Revue der Gesampten Hydrobiologie, Vol. 68, No. 2, p 153-174, 1983. 8 Fig, 4 Tab, 33 Ref.

Descriptors: *Lake sensitivity, *Inorganic enrichment, *Stress analysis, *Induced fertilization, Eutophication, Phosphorous, Nitrogen, Deposition.

The introduction of P and N loads exceeding 4-14 and 1-2 times, respectively, and the amount of these nutrients stored in the waters of four lakes (dystrophic and eutrophic, stratified and unstratified) resulted in stronger, two-phased changes in Ptot standing stock and in rather insignificant and non-directed changes in Ntot in all lakes. There was an immediate increase of Ptot which followed by a decrease in Ptot together with a decrease in the N:P ratio. The final level was higher than in the control. The top layer of off-littoral sediments had a temporary accumulation of nutrients followed by their release to a level significantly lower than that in the control year. Visible changes in the nutrient content and total biomass of above-ground parts of macrophytes were only in the lake which was previously highly dystrophic, after it had been limed. This lake reacted strongest to the P load, and the release of nutrients from its deposits started simultaneously with fertilization. The reduction in the N:P ratio in the lake waters was mainly responsible for the lack of assimilation of further doses of P. The acceleration of denitrification process caused by the higher overall lake productivity was responsible for the stabilization and removal of the N load. The activation of bacterial decomposition in the sediments due to the increase in lake productivity and sedimentation rate was the probable reason for the acceleration of the nutrients release from the top layers of the sediments and their further physical transport to deeper layers. (Murphy-IVI)
W84-02949

2I. Water In Plants

CARBOHYDRATE PARTITIONING IN RELATION TO WHOLE PLANT PRODUCTION AND WATER USE OF VIGNA UNGUICULATA (L.) WALP.,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
E.-D. Schulze, K. Schilling, and S. Nagarajah.
Oecologia, Vol. 58, No. 2, p 169-177, May, 1983. 10 Fig, 17 Ref, 1 Append.

Descriptors: *Water requirements, *Plant growth, *Carbohydrates, Biomass, Transpiration, Roots, Leaves, Carbon, Evapotranspiration.

Experiments with Vigna unguiculata at two levels of evaporative demand and two levels of water uptake capacity of the root were undertaken to analyze carbon partitioning patterns with respect to water utilization. Theoretical considerations were made based upon optimization theory, especially by application of the Pontryagin Maximum Principle, that in some cases carbohydrate partitioning is dependent upon the transpiration rate per leaf weight and upon the efficiency of the root at taking up water. Growth of V. unguiculata at two levels of air humidity and water uptake rate was consistent with such a carbohydrate partitioning pattern. Growth of total biomass and its components (leaves, stems, and roots), whole plant transpiration, and the pattern of carbon partitioning were predicted and explained by applying the foregoing principles of optimization in a heuristic model for vegetative growth of an animal. (Baker-IVI)
W84-02489

ROOTING PATTERN AND WATER RELATIONS OF THREE PASTURE GRASSES GROWING IN DRYING SOIL,
Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences.
D. E. Molyneux, and W. J. Davies.
Oecologia, Vol. 58, No. 2, p 220-224, May, 1983. 5 Fig, 1 Tab, 19 Ref.

Descriptors: *Grasses, *Water requirements, Plant growth, Water stress, Roots, Turgor, Water deficit, Soil water.

The water relations and rooting patterns of three common pasture grasses were examined to determine if turgor maintenance in roots can act to maintain or even promote the growth of roots in drying soil. The effects of water deficit on the absolute length of root and the rooting patterns of the grasses were also determined. Root turgor of Dactylis was larger than that of Lolium and Phleum. As a result of accumulation of solutes, turgor of Dactylis and Lolium was maintained as the soil dried. Phleum roots lost turgor in drying soil and this characteristic correlated well with a water stress induced reduction in root and shoot growth. Soil drying had marked effects on the rooting patterns of two of the three species. Phleum seedlings which in wet soil are deep rooting were restricted in their depth of rooting, while roots of water stressed Dactylis seedlings grew deeper into the profile than did roots of well watered plants. When water was withheld from plants, deeper rooting apparently resulted in a more favorable shoot water balance which had a beneficial effect on shoot growth. (Baker-IVI)
W84-02490

DROUGHT RELATIONS OF SHRUB SPECIES: ASSESSMENT OF THE MECHANISMS OF DROUGHT RESISTANCE,
Washington Univ., Seattle. Coll. of Forest Resources.
T. M. Hinckley, F. Duhme, A. R. Hinckley, and H. Richter.
Oecologia, Vol. 59, No. 2-3, p 344-350, 1983. 4 Fig, 4 Tab, 29 Ref.

Descriptors: *Drought resistance, *Shrubs, Plant water potential, Root distribution, Osmotic potential, Stomata, Water stress.

Relatively static factors such as depth of rooting and cuticular conductance and relatively dynamic factors such as stomatol control and changes in the components of water potential were used to assess the drought resistance characteristics of six deciduous shrub species. Predawn water potential during a prolonged drought averaged -2.13 and -3.51 MPa in species known to have deep and shallow patterns of rooting, respectively. It is thus surprising that the osmotic potential at the turgor loss point averaged only -3.01 MPa in the shallow rooted group. The water potential at which irreversible cell damage occurred was the same in both groups (04.9 MPa), and minimum values observed in the field never dropped below -4.0 MPa. There was, however, a pronounced difference between the two groups with regard to stomatal behavior. This allowed us to characterize the deep-rooted species as avoiders of stress which cause prolonged stomatal closure whereas the shallow-rooted species had to tolerate prolonged periods of closed stomata. (Author's abstract)
W84-02491

EXPERIMENTAL REMOVAL OF INTRASPECIFIC COMPETITORS - EFFECTS ON WATER RELATIONS AND PRODUCTIVITY OF A DESERT BUNCHGRASS, HILARIA RIGIDA,
California Univ., Los Angeles. Dept. of Biology.
R. Robberecht, B. E. Mahall, and P. S. Nobel.
Oecologia, Vol. 60, No. 1, p 21-24, 1983. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Soil-water-plant relationships, *Competition, *Hilaria, *Productivity, Soil water potential, Deserts, Growth, Biomass, Root development, Sonoran Desert, California.

Intraspecific competition in the C4 bunchgrass Hilaria rigida was examined on a Sonoran Desert site in southeastern California. Potential competition within monospecific stands was experimentally altered by removal of the aboveground portions of all plants within a 1.5 m radius of a monitored plant. Compared with unaltered plots, altered plots had less negative soil water potentials during period of soil drying. Leaf blades on monitored

plants of altered plots remained green longer and had greater stomatal conductances than those on monitored plants on unaltered plots. Production of new culms was twice as great on altered plots. Greater root biomass and root length were observed in altered plots, and root extension into soil areas formerly occupied by roots of neighboring plants occurred within one year after treatment. The results indicate that removal of the aboveground biomass of neighboring plants reduces the competition for limited available soil water in this desert environment. (Author's abstract)
W84-02495

STRESS-INDUCED RIPENING OF THE NON-RIPENING TOMATO MUTANT NOR,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Applied Research Inst.
S. M. Arad, and Y. Mizrahi.
Physiologia Plantarum, Vol. 54, No. 2, p 213-217, October, 1983. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Water stress, *Tomatoes, *Ripening, Drought, Transpiration, Kinetin, Fruit.

Tomato (Lycopersicon esculentum Mill.) plants of the non-ripening mutant nor (3rd backcross to the normal cultivar Rutgers) were grown under water stress induced in two different ways: a) reduction of water supply and b) increase in transpiration rate by adding kinetin to the nutrient solution. Both drought treatments induced fruits of the non-ripening mutant nor to ripen, that is, the parameters characteristic of ripening - red pigment, taste, pectolytic activity, softening, and the evolution rates of CO2 and ethylene - all increased, although not to the normal level. Such an increase does not normally take place in the nor mutant under control conditions. It is suggested that fruits of the nor mutant can be induced to ripen by any kind of water stress. The induction mechanism is still to be explored. (Author's abstract)
W84-02499

FURTHER STUDIES IN FLOOD TOLERANCE OF BETULA PAPYRIFERA SEEDLINGS,
Wisconsin Univ.-Madison. Dept. of Forestry.
Z. C. Tang, and T. T. Kozlowski.
Physiologia Plantarum, Vol. 59, No. 2, p 218-222, October, 1983. 1 Fig, 4 Tab, 27 Ref.

Descriptors: *Flooding, *Seedlings, *Birch trees, Roots, Adventitious roots, Growth, Flood tolerance.

Flooding of soil for 60 days drastically reduced height growth, cambial growth, dry weight increment, and relative growth rate of 150-day-old Betula papyrifera Marsh seedlings. Comparisons of responses to flooding of 150-day-old and 230-day-old seedlings indicated important differences between the two age classes. Whereas the younger seedlings produced abundant adventitious roots on submerged portions of stems, the older seedlings did not. Flooding also induced much more leaf abscission in the older seedlings. Flooding generally reduced root-shoot ratios of both age classes, largely as a result of inhibition of growth and decay of root systems. However, root-shoot ratios were altered appreciably by formation of adventitious roots in the younger seedlings and by extensive leaf abscission in the older seedlings. (Author's abstract)
W84-02500

RESPONSES OF LOBLOLLY PINE (MESOPHYTE) AND SWAMP TUPELO (HYDROPHYTE) SEEDLINGS TO SOIL FLOODING AND PHOSPHORUS,
Clemson Univ., SC.
D. D. Hook, D. S. Debell, W. H. McKee, Jr., and J. L. Askew.
Plant and Soil, Vol. 71, No. 1-3, p 387-394, 1983. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Flooding, *Seedlings, *Pine, *Tupelo, *Phosphorus, Nutrients, Anaerobic conditions, Growth, Iron.

In a pot study, flooding reduced growth of loblolly pine (LP) seedlings and caused an imbalance of nutrients, particularly Fe, in the tops. Swamp tupelo (ST) suffered none of these problems. Also under anaerobiosis, LP roots leaked 85% of total ethanol production into solution whereas ST leaked only 55%. Application of phosphorus increased LP growth under flooded and drained conditions but ST only under drained conditions. The differential response of the two species to flooding suggests that poor energetics and the leaky nature of LP roots under anaerobiosis restricts its growth in such habitats. Application of phosphorus (P) appears to amend these conditons in LP by reducing moisture stress, reducing nutrient imbalances, and improving energetics in older seedlings. ST, the hydrophyte, avoids the problems of soil flooding via adaptions in anaerobic metabolism and oxidation of the rhizosphere. (Author's abstract)
W84-02501

SOIL TEMPERATURE AND FLOODING EFFECTS ON TWO SPECIES OF CITRUS; I. PLANT GROWTH AND HYDRAULIC CONDUCTIVITY,
Agricultural Research and Education Center, Lake Alfred, FL.
J. P. Syvertsen, R. M. Zablotowicz, and M. L. Smith, Jr.
Plant and Soil, Vol. 72, No. 1, p 3-12, 1983. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Soil temperature, *Flooding, *Citrus, *Growth, *Permeability coefficient, Lemon, Orange, Seedlings, Root conductivity, Plant water potential.

Rough lemon (Citrus jambhiri Lush.) and sour orange (C. aurantium L.) seedlings were grown at constant soil temperatures of 16, 24, and 33 degrees C for 3 months. Shoot and root growth of rough lemon was greatest at 33 degrees C while growth of sour orange was greatest at 24 degrees C. There were no significant effects of soil temperature on shoot : root ratio, leaf water potential or stomatal conductance. The hydraulic conductivity of intact root systems of both species was highest when seedlings were grown at 16 degrees C. Thus, acclimation through greater root conductivity at low soil temperature may have compensated for decreased root growth at 16 degrees C and negated effects of soil temperature on plant water relations. Half the plants growing at each soil temperature were subsequently flooded. Within 1 week, the soil redox potential (Eh) dropped below zero mV, reaching a minimum Eh of - 250mV after 3 weeks of flooded conditions. Flooded plants exhibited lower root conductivity, a cessation of shoot growth, lower leaf water potentials, lower stomatal conductances, and visual sloughing of fibrous roots. Decreases in root conductivity in response to flooding were large enough to account for the observed decreases in stomatal conductance. (Author's abstract)
W84-02502

RESPONSE OF UPLAND RICE VARIETIES TO DROUGHT STRESS; II. SCREENING RICE VARIETIES BY MEANS OF VARIABLE MOISTURE REGIMES ALONG A TOPOSEQUENCE,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
B. Mambani, and R. Lal.
Plant and Soil, Vol. 73, No. 1, p 73-94, 1983. 10 Fig, 8 Tab, 22 Ref.

Descriptors: *Rice, *Drought, *Water stress, Soil water, Water table, Root distribution, Soil-water-plant relationships.

The effects of variable soil moisture regimes also a toposequence on root development, plant water status, and grain yield were investigated for ten rice varieties: (1) 63-83, (2) IB43, (3) OS6, (4) IB6, (5) IR 1529-680-3, (6) C22, (7) IRAT-13, (8) TOS 4680, (9) IET 1444 and (10) SE302G. The depth of water table below the soil surface in three regions along the toposequence was 100 (M1), 30 (M2) and 15 cm (M3). Soil moisture regime did not affect total root dry weight significantly. However, depth of root penetration did vary for the different moisture regimes and varieties investigated. The angle of root penetration was also affected by soil moisture regime. Roots of tall varieties (63-83, IB6 and IRAT 13) penetrated deeper into the soil profile than short varieties. The pattern of soil moisture depletion was similar to that of root density profile. Relative water stress, expressed as a ratio of leaf water deficit under the M1 moisture regime to that under M3, increased exponentially with decrease in root density at a depth of 25 cm. The mean grain yield of ten varieties exhibited normal distribution under an adequate soil moisture regime (M1), the distribution pattern changed under the adverse regime. Variety IB6 and other tall varieties maintained stable yields under the adverse moisture regime. Grain yield was linearly related to root density at a depth of 25 cm. (Author's abstract)
W84-02504

RESPONSE OF UPLAND RICE VARIETIES TO DROUGHT STRESS; III. ESTIMATING ROOT SYSTEM CONFIGURATION FROM SOIL MOISTURE DATA,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
B. Mambani, and R. Lal.
Plant and Soil. Vol. 73, No. 1, p 95-104, 1983. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Rice, *Drought, *Soil water, *Root distribution, Soil water potential.

Root density profile of three varieties grown along a toposequence under three soil moisture regimes was estimated from soil moisture depletion patterns in the soil profile. Each of the three varieties, IB 6, IR 1529-680-3 and IET 1444, had a different rooting pattern. The three soil moisture regimes corresponded to water table depths of 100(M1), 30(M2) and 15 cm(M3) below the soil surface. Soil moisture potential was negatively correlated with root density, and the differences in rate of moisture depletion at various depths were due largely to differences in root activity. However, varietal differences in root activity were observable only within a narrow range of soil moisture potential, generally above -0.06 bar. The relationship between soil moisture status and root density distribution in the soil profile offers a quick means of estimating varietal differences in root activity at various depths. If evaporation can be minimized, and the soil is horizontally uniform, simultaneous measurements of the moisture status under bare and cropped plots may help to determine the maximum rooting depth accurately. (Moore-IVI)
W84-02505

DIURNAL AND SEASONAL WATER RELATIONS OF THE DESERT PHREATOPHYTE PROSOPIS GLANDULOSA (HONEY MESQUITE) IN THE SONORAN DESERT OF CALIFORNIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
E. T. Nilsen, M. R. Sharifi, P. W. Rundel, W. M. Jarrell, and R. A. Virginia.
Ecology, Vol. 64, No. 6, p 1381-1393, 1983. 11 Fig, 67 Ref. NSF grant DEB 79-21971.

Descriptors: *Mesquite, *Phreatophytes, *Water stress, *Seasonal variation, *Sonoran Desert, *California, Diurnal variation, Groundwater, Soil water potential, Transpiration, Soil-plant-water relationships, Plant water potential, Soil salinity, Stomata, Osmotic pressure, Water availability.

Prosopis glandulosa var. torreyana in the Sonoran Desert of southern California acquired its water from a ground water source 4-6 m deep. Harper's Well, the test site, lies at an elevation of -30 m at the base of the Fish Creek Mountains, 15 km west of the southern tip of the Salton Sea. Diurnal and seasonal cycles of aboveground environmental conditions, soil moisture, and soil water potential (to 6 m depth) were measured to determine environmental water availability and water stress. Leaf water potential, leaf conductance, leaf transpiration, relative saturation deficit of leaves, osmotic potential, and turgor potential were measured to evaluate plant adaptations to environmental water

stress. Soil water potential was low (-4.0 to -5.0 MPa) in surface soil in relation to deep soil (-0.2 MPa). The difference was due to high surface soil salinity and low surface water content. Climatic conditions at the research site produced extreme water stress conditions in summer months when temperatures reached 50 C, vapor pressure deficit (VPD) reached 8 kPa, and surface soil water potential was below -4.5 MPa. Considerable plant water stress developed in these trees (midday leaf water potential -4.8 MPa), but osmotic adjustment occurred and turgor was maintained on a diurnal and seasonal cycle. P. glandulosa has adapted to avoid water stress by utilizing deep ground water, but this phreatophyte has also evolved physiological adaptations, such as osmotic adjustment and seasonally changing stomatal sensitivity to VPD, which result in greater tolerance of water stress. (Moore-IVI)
W84-02541

2J. Erosion and Sedimentation

SOIL DISPERSIBILITY,
Wisconsin Univ.-Madison. Dept. of Soil Science.
A. Dong, G. Chesters, and G. V. Simsiman.
Soil Science, Vol. 136, No. 4, p 208-211, October, 1983. 4 Tab, 11 Ref. EPA grant R005142.

Descriptors: *Soil erosion, *Soil dispersibility, Sediment transport, Clay, Organic carbon, Simulation, Ultrasound, Soil properties.

Samples of six surface soils, two subsurface soils, and one organic soil from the Menomonee River Watershed, Wisconsin were dispersed by shaking with water to simulate natural water erosion and particle transport conditions, and ultrasound to provide complete dispersion. The shaking treatment consists of end-over-end agitation of a 1:10 wt:vol soil:water mixture for 0.5 to 128 hours, and the ultrasound treatment was for a 15-minute period. The ratio of the amount of clay-sized particles dislodged by shaking to the amount of clay-sized particles obtained by ultrasound treatment was used to measure ease of dispersibility of soils. Samples with clay-sized particles that disperse readily under the shaking treatment have a higher dispersibility ratio than samples with clay-sized particles that remain intact as aggregates, If a 4-hour shaking treatment simulates the onset of soil erosion conditions in the field, as much as 90% of the primary clay-sized particles remain intact as silt-sized or larger aggregates. The clay dispersibility ratio was significantly correlated with organic carbon content in an inverse relationship. The significant 1/x relationship between organic carbon content and clay dispersibility indicates that increasing organic matter content, for example by addition of sewage sludge, would increase aggregate stability of mineral soils. (Moore-IVI)
W84-02517

EFFECT OF FIRE ON HYDROPHOBIC AND CEMENTING SUBSTANCES OF SOIL AGGREGATES,
Consiglio Nazionale delle Ricerche, Pisa (Italy). Ist. per la Chimica del Terreno.
G. Giovannini, and S. Lucchesi.
Soil Science, Vol. 136, No. 4, p 231-236, October, 1983. 3 Tab, 18 Ref.

Descriptors: *Fires, *Hydrophobic soils, *Soil erosion, *Soil aggregates, Cementing substances, Organic matter, Sardinia, Italy.

Repeated fires are common on grassland during the Italian hot season. Some fires start accidentally, but most, especially on the Sardinian island, are set for the purpose of converting the Mediterranean chaparral to grassland for sheep grazing. Many Italian soils over which fire has passed are intensely eroded. To clarify the effect of fire on some factors associated with the soil erodibility, such as soil organic matter content, aggregate stability, and hydrophobic and cementing substances, an experimental burning was performed in a selected watershed characterized by surface layers of soil that repel water slightly. After the fire had passed, a decrease in soil organic matter content in the upper soil layers was noted, connected wih the disappearance of the resistance to wetting and with the lowering of the aggregate stability. The upper part of the underlying B horizons showed an accumulation of organic matter and an increase in aggregate stability. No evidence for soil hydrophobicity was detected, but the discrepancy may be explained by the fine texture of the soil tested. The deeper horizons were practically unaffected by the fire. (Moore-IVI)
W84-02518

GEOCHEMISTRY OF THE AMAZON; 2. THE INFLUENCE OF GEOLOGY AND WEATHERING ENVIRONMENT ON THE DISSOLVED LOAD,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W84-02560

CAUSES OF RIVER BED DEGRADATION,
For primary bibliographic entry see Field 8B.
W84-02753

SOIL LOSS-SEDIMENT YIELD TO SILVER LAKE, MISSOURI,
Soil Conservation Service, Columbia, MO.
V. L. Finney.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 4, p 405-409, November, 1983. 3 Fig, 7 Tab, 15 Ref.

Descriptors: *Silver Lake, *Missouri, *Soil loss, *Sediment yield, Sediment deposition, Drainage area, Soil erosion.

Silver Lake, approximately 3,050 acres, is the largest of three reservoirs in the Swan Lake National Wildlife Refuge, Missouri. A sedimentation survey, cesium 137 analyses, and soil loss calculations were used to estimate the average rate and variability in rates of sediment deposition in Silver Lake, and soil loss rates in the Silver Lake drainage area. The rates of soil loss and sediment deposition have been relatively constant since 1957. Silver Lake is estimated to be filling at an average rate of 43.75 acre ft. This rate gives an average annual water depth loss of 0.4 cm. If this rate of sedimentation is allowed to continue, Silver Lake will be filled with sediment in 280 yr. Continued sediment deposition in Silver Lake will induce flora and fauna changes. (Moore-IVI)
W84-02833

RIVERBANK EROSION - A CASE STUDY,
Louisville Univ., KY.
D. J. Hagerty, M. Sharifounnasab, and M. F. Spoor.
Bulletin of the Association of Engineering Geologists, Vol. 20, No. 4, p 411-437, November, 1983. 19 Fig, 33 Ref.

Descriptors: *Bank erosion, *Ohio River, *Kentucky, Water currents, Wind waves, Water level fluctuations, Precipitation, Alluvium, Floods, Boats, Waves.

A field study of riverbank erosion was carried out during a 13-month period at five sites along the Ohio River near Louisville, Kentucky. The soils at the sites consisted of layered alluvium; the fraction of total bank height composed of sandy layers varied widely from site to site. The influences of high-water currents, wind waves and vessel waves also varied from one location to another. Bank material loss/gain was measured by means of pins and tubes installed on a grid pattern, together with a base line, at each site. A regular program of photography at each site further depicted bank changes. Data were gathered on river level fluctuations and precipitation during the study. The severity of erosional loss appeared to depend principally on the bank materials; sandy banks retreated farthest during the study. Episodes of bank material loss coincided with periods of high water, particularly when bank materials were wetted by antecedent precipitation before flood events. Flow of water out of previous layers of alluvium was found to be a major factor in causing failure. Wave action was seen to be an insignificant cause of erosion at the five sites studied. (Author's abstract)
W84-02834

MEANDER BENDS OF HIGH AMPLITUDE,
Minnesota Univ., Minneapolis.
For primary bibliographic entry see Field 8B.
W84-02867

STATISTICAL PROPERTIES OF SEDIMENT MOVEMENT,
National Univ. of Singapore. Faculty of Engineering.
H.-F. Cheong, and H.-W. Shen.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1577-1588, December, 1983. 11 Fig, 10 Ref, 2 Append. NSF grant ENG-7825054.

Descriptors: *Sediment transport, *Dispersion, Statistical analysis, Dunes, Particulates, Time rate, Space rate, Rest duration, Step length.

The discrete unidirectional movement of a contaminated sediment particle along the bed of an alluvial channel is assumed to take place in a series of alternate rest and transport periods. On the assumption that the downstream dispersion of sediment bed particles can be represented by a stationary point process in space and time domains, plausible forms of the probability density functions of the particle step length and rest duration are derived from their corresponding rate parameters. Time rate parametric functions yield monotonically decreasing forms of density functions for rest durations. The proposed space rate parameter gives step length density functions whose form vary from the exponential curve to the bell-shaped configuration. Experimental evidence supports a bell-shaped form for step length density functions for tracer motion over a dune bed. The proposed time rate parameter and space rate parameter yielded rest duration and step length density functions which represented good fits to the experimental results obtained for dune bed conditions. Sediment motion over a dune bed may be approximated by a stationary point process in time and space. (Moore-IVI)
W84-02873

SEDIMENT TRANSPORT IN STRATIFIED TURBULENT FLOW,
Southern Illinois Univ. at Carbondale. Dept. of Thermal and Environmental Engineering.
B. A. DeVantier, and B. E. Larock.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1622-1635, December, 1983. 5 Fig, 1 Tab, 13 Ref, 2 Append. NSF grant CME-7914762.

Descriptors: *Sediment flow, *Turbulent flow, *Stratified flow, Density gradients, Mathematical models, Velocity, Open-channel flow, Multidimensional flows.

An accurate description of many environmental and industrial processes depends upon a good prediction of sediment transport behavior in fluids. Often sediment concentration gradients create density gradients in the bulk fluid which give rise to density currents or stratified flow. Since many problems of practical interest can not be represented as unidirectional flows, a transport model which can be applied to multidimensional flow problems is needed. A mathematical model of sediment laden, density affected turbulent flows is presented. The finite element technique is used in conjunction with the Newton iterative method to solve the resulting partial differential equations. The model satisfactorily predicts velocity and concentration profiles for unidirectional open channel flows. Based on its predictive ability for unidirectional flows, the present model would be applicable to multidimensional flows. Because the model does less well at high volume fractions, improved modeling of particle interactions and a modified settling velocity appear to be needed to improve results. Because the correct trends are noted when velocity and concentration equations are decoupled, and because the dispersion mechanism has been tested

by cases which have no convection effects, the extension of the model to more complex flows is warranted. (Moore-IVI)
W84-02876

SEDIMENT TRANSPORT CHARACTERISTICS OF THE DESERT STREAMS IN INDIA,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Basic Resources Studies.
K. D. Sharma, N. S. Vangani, and J. S. Choudhari.
Journal of Hydrology, Vol. 67, No. 1-4, p 261-272, 1984. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Sediment transport, *Deserts, *Ephemeral streams, Arid lands, Sediment rates, Sediment concentration, Sediment yield, Sedimentary structures, India.

Runoff and sediment data from 33 stream gauging stations in the arid region of India determines the relationships existing between sediment concentration and sediment yield to the runoff discharge in the desert streams. Sediment concentrations varied from 0.2-53.5 g/l on hillslopes to 1-453 g/l in the downstream channels in alluvium tracts. Similarly, suspended-sediment loads of these streams varied from 1.6-445.7 to 0.6-1082.0 t/sq km per event in hilly and alluvium tracts, respectively. Downstream increase in the sediment concentrations is attributed to the cessation of minor flows due to heavy transmission losses in the alluvium, thus leaving large amounts of loose material which is picked up by the subsequent flows of greater magnitude. The highest concentrations are recorded in the initial runoff, followed by a rapid decrease in concentration during the rising and recession flow stages. There is no correlation between observed sediment concentration and runoff rates. These results are tentatively explained by the varying role of splash and flow velocity on sediment detachment and transport processes during the flow events. (Murphy-IVI)
W84-02897

ESTIMATION OF SOIL EROSION IN INDIA,
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
D. V. V. Narayana, and R. Babu.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 419-434, December, 1983. 7 Fig, 4 Tab, 29 Ref.

Descriptors: *Soil erosion, *India, Sediment load, Sediment yield, Erosion rates, Model studies.

Soil erosion is a serious problem in India. In the absence of precise estimates of total erosion in the country, this method arrives at a first estimate of soil erosion, sediment loads of rivers and sedimentation in reservoirs. Existing annual soil loss data for 20 different land resource regions of the country, sediment loads of some rivers, and rainfall erosivity for 36 river basins and 17 catchments of major reservoirs are utilized and statistical regression equations predict sediment yield. Using these expressions and corresponding values of area, rainfall, rainfall erosivity and surface runoff, annual values of total sediment loads of streams, sediment deposition in reservoirs, and sediment lost permanently into the sea are estimated. The first approximation of soil erosion is taking place at the rate of 16.35 ton/ha/annum which is more than the permissible value of 4.5-11.2 ton/ha. About 29% of the total eroded soil is lost permanently to the sea. Ten percent of it is deposited in reservoirs. The remaining 61% is dislocated from one place to the other. (Murphy-IVI)
W84-02928

SEDIMENTOLOGICAL STUDIES OF THE 'ILHA DE MARCHANTARIA' IN THE SOLIMOES/AMAZON RIVER NEAR MANAUS,
Institut fuer Meeresgeologie und Biologie, Wilhelmshaven (Germany, F.R.).
G. Irion, J. Adis, W. J. Junk, and F. Wunderlich.
Amazoniana, Vol. 8, No. 1, p 1-18, September, 1983. 15 Fig, 22 Ref.

Descriptors: *Sedimentation, *Amazon River, *Manaus, *Ilha de Marchantaria, Brazil, Islands, Channel bars, Water level fluctuations, River stage, Erosion.

Sedimentological studies on the Ilha de Marchantaria, an island in the Amazon river near Manaus, reveal the existence of four different structural main units. Sandy channel bars were found consisting of giant ripples which constitute deposits for the formation of islands or newly formed areas of the Vazea. Gradual accumulation was seen on the channel bars leading to the formation of point bar ridges which consist chiefly of small-scale ripples. Between point bar ridges of different ages there exist swales. During rising water level the river water flows from the downward side into the swales where finegrained sediments are deposited. Permanent lakes are formed mainly in the center of the islands. During low water periods the lakes may be cut off from the river. During the high water periods when the whole island is flooded by the river, additional sedimentation takes place especially in the upstream are of the island. There is, however, extensive erosion of the banks on the upstream side of the island. By erosion of the upstream end and sedimentation processes on the downstream end the island moves slowly downstream. (Baker-IVI)
W84-02946

2K. Chemical Processes

PLUTONIUM SPECIATION IN WATER FROM MONO LAKE, CALIFORNIA,
Geological Survey, Denver, CO.
J. M. Cleveland, T. F. Rees, and K. L. Nash.
Science, Vol. 222, No. 4630, p 1323-1325, December, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Speciation, *Plutonium, *Mono Lake, California, Solubility, Actinides, Radioactive waste disposal, Carbonates, Fluorides, Water chemistry.

This study of the speciation of plutonium in Mono Lake water was part of a comprehensive investigation of transuranium-element chemistry in ground waters of possible relevance to radioactive waste disposal. The solubility of plutonium was enhanced by the presence of large concentrations of indigenous carbonate ions and moderate concentrations of fluoride ions. In spite of the complex chemical composition of this water, only a few ions govern the behavior of plutonium, as demonstrated by the fact that it was possible to duplicate plutonium speciation in a synthetic water containing only the principal components of Mono Lake water. The chemical composition of the Mono Lake water sample with concentration given in mg/liter was: alkalinity (as CaCO3), 26,300; calcium, 12; iron, 1.0; magnesium, 23; manganese, 0.033; potassium, 1,300; sodium, 26,000; strontium, 0.029; silica, 13; chloride, 22,000; fluoride, 48; phosphate, 20; and sulfate, 8,300; with a pH of 10.0. (Baker-IVI)
W84-02513

SPECIATION OF ALUMINUM IN ACIDIC FRESHWATERS,
Quebec Univ., Sainte-Foy.
P. G. C. Campbell, M. Bisson, R. Bougie, A. Tessier, and J.-P. Villeneuve.
Analytical Chemistry, Vol. 55, No. 14, p 2246-2252, 1983. 3 Fig, 6 Tab, 46 Ref. Environment Canada contract KSD-KA313-1-6026.

Descriptors: *Aluminum, *Speciation, Acidic water, Photooxidation, Ultraviolet, Organic matter, Water chemistry.

The determination of the physical speciation of aluminum in water samples by filtration through polycarbonate membranes proved feasible; control experiments revealed neither contamination nor analyte loss. Treatment of sample filtrates with a fractionally loaded Chelex 100 ion-exchange resin (>75% H(+)-form) allows one to distinguish between different forms of aluminum on the basis of their kinetic and thermodynamic properties. Monomeric hydroxo- and fluoroaluminum complexes exchanged readily (>85% after 30 min), as did low molecular weight polynuclear species. Under similar conditions, forms of Al associated with fulvic and humic acids of natural origin exchanged much more slowly (<5% after 30 min, at an Al:dissolved organic carbon atomic ratio of about 1:155). Before photooxidation, the filterable aluminum present in natural waters exhibited intermediate behavior (0-50% exchange after 30 min); after UV irradiation the nonexchangeable Al fraction had practically disappeared (90-96% exchange after 30 min), suggesting that the major portion of the nonexchangeable Al initially present was associated with organic matter. (Author's abstract)
W84-02558

GEOCHEMISTRY OF THE AMAZON; 2. THE INFLUENCE OF GEOLOGY AND WEATHERING ENVIRONMENT ON THE DISSOLVED LOAD,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
R. F. Stallard, and J. M. Edmond.
Journal of Geophysical Research, Vol. 88, No. C14, p 9671-9688, November, 1983. 13 Fig, 6 Tab, 92 Ref.

Descriptors: *Geochemistry, *Amazon Basin, *Weathering, *Dissolved solids, Erosion, Water chemistry, Substrates, Salts, Geology, Cations, Silicates, Evaporites, Rivers.

In the Amazon Basin, substrate lithology and erosional regime (seen in terms of transport-limited and weathering-limited denudation) exert the most fundamental control on the chemistry of surface waters within a catchment. Secondary effects, such as the precipitation of salts within soils and in stream beds, biological uptake and release, and cyclic salt inputs, are more difficult to discern. Samples can be separated into four principal groupings based on relationships between total cation charge (TZ+) and geology. (1) Rivers with 0<TZ+<200 micro eq/l drain the most intensely weathered materials (Upper Tertiary sediments, soils of the Negro Basin, and similarly weathered regions). These rivers show high levels of Fe, Al, H(+), and coloration and are enriched in Si relative to other major species; they exhibit cation ratios similar to those of substrate rocks. (2) Rivers with 200<TZ+<450 micro eq/l drain siliceous terrains. These rivers are also rich in silica relative to other species. Rivers draining weathering-limited siliceous terrains exhibit the highest TZ+, and their cation load is typically preferentially enriched in Na over K and Ca over Mg when compared to the rocks in their catchments. (3) Rivers with 450<TZ+<3000 micro eq/l drain marine sediments or red beds with high cation concentrations (resulting from the presence of carbonates and minor evaporites in the Peruvian Andes and reduced shales and minor carbonates in the Bolivian Andes). These rivers exhibit relatively high levels of Ca, Mg, alkalinity, and SO4 (in rivers draining reduced shales and minor evaporites). (4) Rivers with TZ+>3000 micro eq/l drain massive evaporites. These rivers are rich in Na and Cl. In the third and fourth categories, rivers tend to have 1:1 (equivalent) ratios of Na:Cl and (Ca + Mg):(alkalinity + SO4), caused primarily by the weathering of carbonates and evaporites. (Author's abstract)
W84-02560

SOME ELEMENTS COMPRISING PARTICULATE MATTER DURING SUMMER IN WATERS OF VARIOUS ENVIRONMENTS IN BRITISH COLUMBIA, CANADA,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W84-02725

THE STABILIZATION OF 'DISSOLVED' IRON IN FRESHWATERS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
A. J. Cameron, and P. S. Liss.
Water Research, Vol. 18, No. 2, p 179-185, 1984. 3 Tab, 21 Ref.

Descriptors: *Iron, *Colloids, *Dissolved iron, Natural waters, Humic acids, Tannic acids, Surfactants, Silicates, Phosphates, Hydrogen ion concentration, Aggregation.

In many natural waters Fe(III) exists in an apparently 'dissolved' state at concentrations far higher than predicted from straightforward inorganic solution chemistry. Some of the iron may exist as organic complexes, but it seems more likely that most is present as fine colloidal particles which are stabilized against flocculation by adorption of organic and inorganic species from the water. In many studies, 'dissolved' iron is defined as that which is analytically detectable in the filtrate after passage of the water through a membrane having pores of 0.5 millimicron nominal diameter. Laboratory experiments were conducted to see what substances are capable of holding iron at a concentration of about 1 ppm in a 'dissolved' form (i.e. will pass through a 0.45 millimicron pore size filter) in oxygenated water. The reagents capable of doing this include humic and tannic acids, surfactants such as sodium dodecyl sulfate and sodium dodecylbenzene sulfonate, and the inorganic ions silicate and phosphate. The synthetic polymer polyvinylpyrrollidone and the simple ions Cl(-), HCO3(-), SO4(-) and NO3(-) showed no ability to stabilize iron. The efficiency of phosphate at keeping iron in the 'dissolved' state decreased in the presence of cations, particularly divalent ones, but increased with rise in water pH in the range 6-11. It seems unlikely that much of the stabilization observed for any of the reagents tested is due to their forming complexes with the iron. It is more likely that the substances for which positive results were obtained are able to stabilize fine colloidal iron particles and inhibit them from forming larger aggregates. (Moore-IVI)
W84-02747

OBSERVATIONS ON THE CHEMICAL COMPOSITION OF RAIN USING SHORT SAMPLING TIMES DURING A SINGLE EVENT,
Hope Coll., Holland, MI. Dept. of Chemistry.
M. D. Seymour, and T. Stout.
Atmospheric Environment, Vol. 17, No. 8, p 1483-1487, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Rain, *Hydrogen ion concentration, Sampling, Sulfates, Nitrates, Sodium, Potassium, Calcium, Magnesium, Specific conductivity, Particulates, Washout, Michigan.

Studies of changes in the chemical composition of rainfall during a single rainfall event were initiated in the summer of 1979. During that summer, 20 different events were collected and the pH of each sequentially collected sample was measured. The pH of the individual samples varied between 5.8 and 3.6. The most rapid decrease in pH occurred during the early portion of the rainfall event, while only small increases or decreases in the pH occurred during the latter portion of the event. In 1980, sequential samples of rain, each corresponding to 0.23 mm of rainfall, were collected during single precipitation events at a site in western Michigan and analysed for specific conductance, pH, SO4(2-), NO3(-), Na(+), K(+), Ca(2+) and Mg(2+). A rapid decrease in the concentration of all the measured components except H(+) was observed during the initial portion of the event. The H(+) concentration of the rainwater generally increased during the initial portion of the event. This converse relationship between the H(+) concentration and the SO4(2-) and NO(3-) concentrations is attributed to the rapid washout of atmospheric particulates containing basic salts. Depending upon the type and duration of the event, this washout can cause 50% of the total SO4(2-) and NO3(-) deposition to occur during the first 15-20% of the total rainfall. While sampling of this type may not be possible for all studies of precipitation chemistry, further studies using this method may be useful in describing the effect that atmospheric particulates and rainfall amount have on the relationship between the concentrations of SO4(2-) and NO3(-) in rain and the net deposition of H(+) by a single precipitaion event. (Moore-IVI)
W84-02772

KINETIC STUDIES OF RAINDROP CHEMISTRY. I. INORGANIC AND ORGANIC PROCESSES,
California Univ., Berkeley. Dept. of Chemistry.
T. E. Graedel, and K. I. Goldberg.
Journal of Geophysical Research, Vol. 88, No. C15, p 10865-10882, December, 1983. 10 Fig, 6 Tab, 132 Ref.

Descriptors: *Kinetics, *Chemistry of precipitation, Chemical reactions, Rainfall, Precipitation, Model studies, Nitrates, Aldehydes, Ozone, Photolysis, Hydrogen peroxide.

A model has been formulated to represent the chemistry of raindrops, taking into consideration both inorganic and organic processes totaling 94 reactions in 53 species. Three sets of computations were performed for raindrops of different diameters. In the first two, the initial chemistry of the raindrops was set by the cloud chemistry measurements of APEX (Atmospheric Precipitation Experiment) in the northeastern United States. In the simulations the drops were released into tropospheric air charactertistic of either the suburban or urban northeast. In the third set, designed to simulate urban centers on the east coast, raindrops with composition typical of those over the oceans were dropped in urban tropospheric air. Photochemical processes such as the photolysis of hydrogen peroxide to produce hydroxide radicals and the photolysis of nitrate ions to produce ozone, were significant in raindrop chemistry. Organic chemical reactions of interest and importance occur in raindrops, particularly those of small size, with the oxidation of aldehydes to organic acids being the most important. Significant differences in some species concentrations occur at different altitudes during the fall of the raindrop and for drops of different diameters. These differences are related to the scavenging efficiencies and lifetimes of the drops. Given constant initial concentrations of trace species in raindrops, ion concentrations in rainwater increase as the rain rate decreases and in a steady rainfall the concentrations of scavenged ions decrease as the concentrations of the gaseous precursors decrease. Neither effect is large, however. Below-cloud processes probably do not significantly affect the concentration of strong inorganic acids in rain at ground level unless acid concentrations are low in droplets at cloud base. (Baker-IVI)
W84-02824

ESTIMATION OF AQUIFER RECHARGE AND FLOW FROM NATURAL TRITIUM CONTENT OF GROUNDWATER,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
J. S. Colville.
Journal of Hydrology, Vol. 67, No. 1-4, p 195-222, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Groundwater recharge, *Groundwater movement, *Tritium, Natural recharge, Aquifers, Mathematical models, Model studies, Irrigation effects.

Groundwater usually contains tritium which originally fell in rain and entered the aquifer as recharge. The systematic measurement of this natural tritium content can be used to estimate recharge and water flow in the aquifer. The theoretical calculations require some plausible assumptions to be made about the aquifer. It is necessary to discuss any bias that these can produce. In particular, it is assumed that sampling successfully draws water equally from all aquifer depths and that the effects of finite hydraulic conductivity and hydrodynamic dispersion can be neglected. A comparison of theoretical distributions of the tritium concentration in groundwater shows that any model of an aquifer should include the effects of irrigation with local groundwater as well as the variations in the amount of recharge and its tritium concentration. The additional recharge of fresh rain water and loss of pumped groundwater associated with irrigation could not be estimated adequately. Presumably, if irrigation had been established longer and over more of the region, then the additional recharge could be estimated as well as natural recharge. Dispersion plays a negligible role in the interpretation of these experimental data. The sensitivity of these estimates to some of the specific assumptions about recharge and initial conditions is tested by using synthetic data that were calculated according to modified assumptions. (Murphy-IVI)
W84-02894

NITROGEN AND PHOSPHORUS FLUXES FROM A FLOODED ORGANIC SOIL,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and P. S. C. Rao.
Soil Science, Vol. 136, No. 5, p 300-307, 1983. 5 Fig, 14 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Fluctuations, *Flooded organic soil, Organic soils, Ammonification, Nitrification, Detritus, Decomposing organic matter, Floodwater.

Florida has approximately 1.5 million hectares of organic soils, which were formed by the accumulation of the decayed remains of sawgrass and related wetland plants over the last 5000 years. Under laboratory conditions the anaerobic soil layer ammonification was functioning at a rate of 0.11 g N/sq m-day, and NH4+ flux from the anaerobic soil layer to the floodwater and to the aerobic soil layer was 0.045 g N/sq m-day. The sequential N processes functioning in a flooded organic soil include: ammonification in the anaerobic soil layer, upward diffusion of NH4+ from the anaerobic soil layer to the floodwater, nitrification in the floodwater, downward diffusion into the anaerobic soil layer and denitrification in the anaerobic soil layer. Losses due to these processes accounted for about 35% of the mineralized NH4+-N in the 21-cm organic soil column. The ammonification and NH4+ diffusion functioning at a slower rate probably are the limiting processes in N loss from a flooded organic soil. The results also showed that the rate of soluble P production in the anaerobic soil layer was 0.016 g P/sq m-day, and the flux of P, as a result of diffusion, was about 0.0098 g P/sq m-day. Major processes functioning in the anaerobic layer were mineralization of organic P, adsorption-desorption of P, and diffusion from underlying sediment to the overlying water. Losses of P due to these processes accounted for about 53% of the solubilized P in the 21-cm organic soil column. (Murphy-IVI)
W84-02908

SEASONAL VARIATION IN THE MAJOR CATION (NA, K, MG, AND CA) CONTENT OF THE WATER OF LAGO CAMALEAO, AN AMAZONIAN FLOODPLAIN-LAKE NEAR MANAUS, BRAZIL,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch, W. J. Junk, J. Dieterich, and N. Kochert.
Amazoniana, Vol. 8, No. 1, p 75-89, September, 1983. 6 Fig, 28 Ref.

Descriptors: *Seasonal variations, *Cations, *Lago Camaleao, *Brazil, *Floodplain lakes, Potassium, Sodium, Calcium, Magnesium, Amazon River, Electrolytes, Water level, Nutrients.

Changes in the major cation content of the Lago Camaleao, one of the varzea lakes on an island in the Rio Solimoes/Amazonas near Manaus were monitored for one year. Changes in the electrolyte content of the lake water, presented as total major cation content, were extremely great during the period of investigation. November 1980 to November 1981 showed a pronounced annual periodicity. During the low water period the ion concentration reached its maximum, more than 15 times the concentration in the river at the same time. With rising water level, inflow of comparatively electrolyte poor water from the river and simultaneously increasing rainfall diluted the water in the lake. The electrolyte concentration was not uniform throughout the lake. Concentrations rise from the lake entrance to the inner part of the lake, so that the lake sections distant from the river are up to fifteen times as rich in electrolytes as the river

itself. The uptake of large quantities of nutrients from the system for the growth of macrophytic vegetation, the accumulation of nutrients in macrophytes and sediment, and the release of these nutrients during decomposition and resuspension are among the most important factors contributing to the electrolyte budget in the Lago Camaleao. (Baker-IVI)
W84-02947

2L. Estuaries

NUTRIENT DYNAMICS IN SMALL MESOTROPHIC FENS SURROUNDED BY CULTIVATED LAND; I. PRODUCTIVITY AND NUTRIENT UPTAKE BY THE VEGETATION IN RELATION TO THE FLOW OF EUTROPHICATED GROUND WATER,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
For primary bibliographic entry see Field 5C.
W84-02496

FACTORS REGULATING ABUNDANCE AND DISTRIBUTION OF THE SHRIMP NEOMYSIS MERCEDIS IN THE SACRAMENTO - SAN JOAQUIN ESTUARY,
California State Dept. of Fish and Game, Sacramento.
A. C. Knutson, Jr., and J. J. Orsi.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 476-485, July, 1983. 7 Fig, 2 Tab, 21 Ref.

Descriptors: *Estuarine environment, *Shrimp, *Salinity, Water circulation, Drought, Saline water intrusion, Copepods, Food, Deltas, Population dynamics, Pumping plants, Environmental effects.

The mysid shrimp Neomysis mercedis is a major prey of striped bass Morone saxatilis in the inland delta and estuary of the Sacramento and San Joaquin rivers, California. Its abundance during 1968-1981 was highest between 1.2 and 4.6% surface salinity. Cross-delta flow of water to large pumping plants and shallow river channels with high current velocities limited the upstream extent of the shrimp. The population shifted spatially in response to salinity changes caused by variations in river outflow. Annual July to October abundance indexes were highest from 1968 to 1975, and lowest during the drought years 1976 and 1977. Regression analysis showed that population size was negatively related to salinity intrusion and positively related to the abundance of the copepod Eurytemore affinis, an important food item of the shrimp. High N. mercedis populations appear dependent an adequate food supply and minimal salinity intrusion into the western delta. (Author's abstract)
W84-02523

PRODUCTION AND POPULATION DYNAMICS OF CAPITELLA CAPITATA,
Southampton Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W84-02552

OBSERVATIONS ON THE DISTRIBUTION AND MOVEMENTS OF MACROBRACHIUM OHIONE (SMITH, 1874) IN THE PASCAGOULA RIVER ESTUARY, JACKSON COUNTY, MISSISSIPPI, U.S.A. (DECAPODA, PALAEMONIDAE),
University of Southern Mississippi, Hattiesburg. Dept. of Biology.
G. Anderson.
Crustaceana, Vol. 44, No. 2, p 123-140, 1983. 4 Fig, 5 Tab, 33 Ref. NOAA grant 04-8-Mo1-92.

Descriptors: *Estuarine environment, *Shrimp, *Macrobrachium, Pascagoula River, Jackson County, Mississippi, Population dynamics, Habitats, Salinity.

Sampling stations were located at 47 sites in the lower Pascagoula River, Jackson County, Mississippi. Fourteen collecting trips were made into the study area from June 1978 to April 1979. The findings of the systematic trapping portion of the study indicated that specific conductance was inversely correlated with trapping success. Salinity was also inversely correlated to trap catch. Temperature correlated positively with trapping success, along with distance from the river mouth. Neither water depth nor dissolved oxygen were significantly correlated with trapping success. In each collection the number of females exceeded the number of males. The mark-recapture study indicated that from April to midsummer M. ohione exhibits positive rheokinesis in the Pascagoula River study area. Shrimp may move upstream at an average velocity of at least 0.460 km/day. (Baker-IVI)
W84-02637

FRESHWATER WETLANDS HUMAN-INDUCED CHANGES: INDIRECT EFFECTS MUST ALSO BE CONSIDERED,
Ottawa Univ. (Ontario). Dept. of Biology.
P. A. Keddy.
Environmental Management, Vol. 7, No. 4, p 299-302, 1983. 1 Fig, 20 Ref.

Descriptors: *Wetlands, *Ecosystems, *Environmental effects, Vegetation, Succession, Massachusetts, Rhode Island.

With the rapid disappearance of North American wetlands, there is a great need for long-term data on changes in wetland ecosystems over time. Two recent studies have documented changes in wetland ecosystems in New England by examining changes in wetland vegetation over time. Larson and others (1980, J. Appl. Ecol. 17:667-673) studied changes in freshwater wetland ecosystems on the Massachusetts Coastal Plain over a 20 year period, while Golet and Parkhurst (1981, Environ. Manag. 5:245-251) studied Rhode Island wetlands over a 33 year period. Both documented shifts in vegetation towards shrub and forest dominated wetlands. Both then concluded that natural succession has changed more wetlands than human impact has. The last conclusion does not necessarily follow from the data provided. Indirect human impact (for example, water level changes, eutrophication, sedimentation) must be considered when assessing human impact on wetlands, particularly given that subtle indirect impact affects larger areas than direct impact from drainage and infilling. When discussing indirect effects of human activity, it is important to carefully define which indirect effects are being considered, since there is a continuum ranging from infilling through to alteration of global CO2 levels. Given the complexity of indirect effects, it is unlikely that most can be recognized in the field. This will be particularly true for the more subtle human-induced effects such as atmospheric CO2 or acid rain. (Moore-IVI)
W84-02641

FORECASTING THE IMPACTS OF GLOBAL FORCES ON AMERICA'S WETLANDS,
Fish and Wildlife Service, Washington, DC.
W. R. Mangun, PH.D.
Journal of Environmental Systems, Vol. 13, No. 1, p 69-76, 1983-84. 2 Fig, 11 Ref.

Descriptors: *Wetlands, *Forecasting, *Environmental effects, Policy making, Decision making, Dredging, Landfills, Water pollution effects.

The future of this nation's wetlands is being shaped by forces in action throughout this country and around the world. If government decision makers are to develop policies adequate to protect these environmentally sensitive resources, wetland scientists and policy analysts will have to integrate their skills to develop a forecasting capability which will effectively predict how these forces will affect the future status of wetlands. The world's wetlands are facing threats from industrial and post-industrial stresses associated with a highly urbanized environment. The direct threats come in the form of dredging, filling, and pollution. The shift in population and industry from the northeast and north-central to the southeast and southwest will cause increasing pollution loads which will inhibit the capacity of wetlands to perform their basic functions. A little more than half of the original wetland acreage remains in the United States. The policy makers of today have an enormous responsibility to formulate public policies which attempt to take into consideration the future state of the global environment. Long-range planning can be an effective tool in the protection of wetlands. Typical long-range planning activities would include: monitoring, forecasting, goal setting, analysis, policy generation (with appropriate pre-testing), and implementation. (Moore-IVI)
W84-02682

GEOCHEMISTRY AND BIOLOGICAL AVAILABILITY OF IRON AND TRACE ELEMENTS IN THE UPPER FRASER RIVER ESTUARY,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
W. K. Fletcher, G. S. Holmes, and A. G. Lewis.
Marine Chemistry, Vol. 12, p 195-217, 1983. 15 Fig, 2 Tab, 58 Ref. NSERC grant G0450.

Descriptors: *Geochemistry, *Iron, *Trace elements, *Estuarine environment, *Upper Fraser River Estuary, British Columbia, Saline water intrusion, Bioassay, Diatoms, Resuspension, Mixing, Particulates, Cobalt, Copper, Manganese, Lead.

Water samples were collected hourly at three depths from two twenty-five hour stations in the Fraser River estuary (British Columbia). Sampling stations were selected to represent both minimal saline intrusion and prominent salt wedge environments. A bioassay using the diatom Thalassiosira pseudonana was run to evaluate biological availability of the dissolved metals. Inter-element ratios indicate that changes in bulk composition of suspended particulates occur throughout the tidal cycle as a result of resuspension and mixing of particulates from different sources. However, Fe:Ti ratios and leachable Fe indicate loss of about 1 wt.% Fe from river-borne particulates mixing with saline waters. This loss from particulates is accompanied by a corresponding increase of 'dissolved' Fe concentrations, from 10 ppb in both fresh waters and the salt water intrusion, to more than 80 ppb in mixed waters of intermediate salinity. Co, Cu, Mn and Pb show similar trends to Fe which are attributed to their association with 'dissolved' Fe colloids. This is consistent with bioassay data which suggests that the biological availability of metals changes abruptly with the change in dissolved Fe concentrations. (Author's abstract)
W84-02691

REQUIREMENTS FOR MODELING TRACE METAL PARTITIONING IN OXIDIZED ESTUARINE SEDIMENTS,
Geological Survey, Menlo Park, CA.
S. N. Luoma, and J. A. Davis.
Marine Chemistry, Vol. 12, p 159-181, 1983. 1 Fig, 4 Tab, 84 Ref.

Descriptors: *Trace metals, *Estuarine environment, *Sediments, Mathematical models, Particulate matter, Oxidation, Sediment-water interface, Partitioning, Calcium, Magnesium, Kinetics.

The fate of particulate-bound metals is of particular importance in estuaries because major biological energy flows involve consumption of detrital particles. The biological impact of particulate-bound metals is strongly influenced by the partitioning of metals among sediment components at the oxidizing sediment-water interface. Adequate methods for directly measuring this partitioning are not available, thus a modeling approach may be most useful. Important requirements for such a model include: (1) determinations of metal binding intensities which are comparable among sediment components important in oxidizing; (2) comparable determinations of the binding capacities of the several forms of each component; (3) operational determinations of the abundance in natural sediments of components of defined binding capacity; (4) assessments of the influence of particle coatings and multicomponent aggregation on the available binding capacity of each substrate; (5) consider-

ation of the effect of Ca and Mg competition on binding to different components; and (6) determinations of the kinetics of metal redistribution among components in oxidized sediments. (Author's abstract)
W84-02692

THE IDENTIFICATION AND EVALUATION OF BENTHIC MACROINVERTEBRATE ASSEMBLAGES IN AN INDUSTRIALISED ESTUARY-SOUTHAMPTON WATER, UK, USING A LONG-TERM, LOW-LEVEL SAMPLING STRATEGY,
Southern Water Authority, Otterbourne (England). Resources Planning Lab.
For primary bibliographic entry see Field 5C.
W84-02694

MESOCOSM EXPERIMENTS TO DETERMINE THE FATE AND PERSISTENCE OF VOLATILE ORGANIC COMPOUNDS IN COASTAL SEAWATER,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W84-02790

THE YANGTZE RIVER; PAST, PRESENT, AND FUTURE,
Woods Hole Oceanographic Institution, MA. Dept. of Geology and Geophysics.
J. D. Milliman, J.-Y. Chen, Z.-S. Yang, and M. Ren.
Oceanus, Vol. 26, No. 4, p 20-25, Winter 1983/84. 3 Fig.

Descriptors: *Rivers, *Sediment transport, *Estuarine environment, Yangtze River, China, Sediments, Erosion, Soil conservation, Streamflow, Flow pattern.

The Tangtze has its origins in Tibetan plateaus where it flows eastward to the East China Sea. The River discharge gains steadily as it flows downstream and an increasing number of northern and southern tributaries join the river. Just before the Yangtze reaches the East China Sea, it divides into several distributary channels. With spring-tide elevations up to 4 to 5 meters, onshore currents can be as great as 3 knots during flood tide. During the ebb, currents reverse and attain speeds of 5 to 6 knots in an offshore direction. This seesaw pattern of current flow accounts for sediments moving in a start-and-stop pattern. It is estimated that the Yangtze estuary is accumulating about 250 million tons of sediment annually, or about half the sediment carried by the river. While it is doubtful that the Yangtze or Yellow rivers carried as much sediment prior to deforestation and disruption of native vegetation by human activity, they undoubtedly contributed vast quantities of sediment to the ocean throughout the Quaternary period. Undoubtedly with future climate changes the discharge patterns of the river will also change. On shorter time scales, even more significant changes may occur as increased efforts of soil conservation lower the sediment load of the river considerably. (Baker-IVI)
W84-02831

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

A METHOD BASED ON EQUILIBRIUM THEORY FOR A CORRECT CHOICE OF A CATIONIC RESIN IN SEA WATER SOFTENING,
Aquila Univ. (Italy). Facolta di Ingegneria.
D. Barba, V. Brandani, and P. U. Foscolo.
Desalination, Vol. 48, No. 2, p 133-146, October, 1983. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Equilibrium theory, *Cationic resin, *Sea water softening, Desalination, Brines, Water softening.

Increase of the performance ratio in evaporative desalination processes is connected with the increase of top brine temperature, i.e. with removal of calcium sulfate from sea water. The softening of sea water by cationic resins and the regeneration of the bed by blowdown from the evaporator is a feasible process. Its economical convenience is dependent on a correct selection of the resin that takes into account both a high selectivity Ca++/Mg++ and a low concentration factor of the blowdown. In fact a high concentration factor is a favorable parameter for the ionic pretreatment but, since it increases the boiling point elevation of the brine, its influence on the evaporation process is negative. For processes at high performance ratios (14-18) a concentration factor ranging from 2 to 4 causes a reduction of logarithmic mean temperature difference of 50-100% and consequently an increase of heat transfer area of 50-100%. A general criterion based on equilibrium theory useful for a correct selection of the resin to be coupled with evaporative process is shown here. The method, that requires only few experimental determinations, has been utilized to compare various commercial resins tested in the laboratory that do not appear completely satisfactory. A sample of a family of 'tailor-made' resins, modified according to the indications derived from the method, is then presented. (Author's abstract)
W84-02929

3B. Water Yield Improvement

ECONOMIC EVALUATION OF WATER HARVESTING IN MICROCATCHMENTS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
G. Oron, J. Ben-Asher, A. Issar, and T. M. Boers.
Water Resources Research, Vol. 19, No. 5, p 1099-1105, October, 1983. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Microcatchments, *Water harvesting, *Cost-benefit analysis, *Nuts, Arid regions, Almonds, Infiltration basins, Economic aspects, Israel.

A microcatchment is a defined area of a few hundred square meters which is used as a water harvesting element for a single tree. Each microcatchment consists of a contributing area and an infiltration basin in which the tree grows. A cost-benefit analysis of the microcatchment water harvesting (MCWH) technique was carried out for for the Wadi Mashash area (Israel) for almond growing. In highly dry zones (i.e., annual precipitation of less than 150 mm), the predicted income is negative. The introduction of modified technology improved water harvesting and thus increased the predicted net income, but these modifications are associated with additional expenses, leaving the additional benefit questionable. A cost-benefit analysis of MCWH with inserts (perforated vertical drainage pipes) to improve water use efficiency indicates that net income is higher than that of MCWH without inserts. In a highly dry zone the net income is still negative (although only slightly), while in dry zones (i.e., annual precipitation of 250 mm) it becomes positive. Another potential route to make the MCWH system more profitable is to use other plant species. One promising possibility is to plant pistachio trees, which survive with limited amounts of water, and which have a larger return than almonds. (Moore-IVI)
W84-02755

STEADY INTERFACE UPCONING BENEATH A COASTAL INFILTRATION GALLERY,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. Das Gupta.
Ground Water, Vol. 21, No. 4, p 465-474, July-August, 1983. 11 Fig, 1 Tab, 23 Ref.

Descriptors: *Coastal aquifers, *Interfaces, *Upconing, Saline-freshwater interfaces, Infiltration, Infiltration gallery, Water supply development, Groundwater withdrawals, Wells.

The problem of steady upconing of an interface in an unconfined coastal aquifer due to water withdrawal by an infiltration gallery has been analyzed numerically considering different operating conditions of the gallery within the flow domain. The numerical solution procedure is based on the variational formulation of the problem and profiles of the free surface and interface along with the length of the outflow face and the quantity of fresh-water flow to the sea are obtained as solutions to the problem. The analysis leads to a set of dimensionless plots which can be used for planning a suitable water withdrawal scheme for different aquifer geometries with isotropic or anisotropic distribution of hydraulic conductivity, assuring the availability of fresh water without any salt contamination. The effect of upconing of the interface on lowering the water table head at the upstream boundary is negligible for the higher domain length-head ratio. It may be possible to approximate an array of wells which is more likely to be installed in many cases of practical interest by an equivalent continuous gallery if the wells are very close, and if well characteristics and discharges are the same. (Baker-IVI)
W84-02807

3C. Use Of Water Of Impaired Quality

WASTEWATER REUSE IN MUSLIM COUNTRIES: AN ISLAMIC PERSPECTIVE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W84-02640

CONTRACTUAL REQUIREMENTS TO IMPLEMENT WATER RECLAMATION,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 6F.
W84-02666

BACTERIOLOGICAL, VIROLOGICAL AND CHEMICAL EVALUATION OF A WASTEWATER-AQUACULTURE SYSTEM,
Murray State Univ., KY. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W84-02719

EVALUATION OF IRRIGATION WATER QUALITY FOR A SPATIALLY VARIABLE FIELD,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
E. Bresler, D. Yaron, and A. Segev.
Water Resources Research, Vol. 19, No. 6, p 1613-1621, December, 1983. 6 Tab, 21 Ref.

Descriptors: *Irrigation water, *Saline water, *Citrus, Soil water, Solute transport, Salt accumulation, Leaching, Root zone, Saline soils, Crop yield, Income, Water costs.

A model to predict the optimal salt concentration of irrigation water when various sources of water are available is described and illustrated for citrus. The model employs a stochastic model for soil water and solute movement and a linear programming economic model for best solutions over an extended time period. The model was developed for a Mediterranean-type climate where an irrigation (salt accumulation) season is followed by a rainfall (salt leaching) period. Soil water flow generated by an irrigation or rainfall is assumed to be steady and vertical. Transient solute transport is assumed to obey the diffusion-convection equation. The probability of any given average root zone salinity after any cycle of irrigation or rain is calculated for any combination of applied water salinity and initial soil salinity using a probability density function for the saturated hydraulic conductivity. The expectation of the total income from a crop yield having a known response function to soil salinity is maximized by the model subject to a given probability of the average root

zone salinity exceeding a prespecified critical concentration. The cost of water is assumed to decrease as the salinity of irrigation water increases. Optimal water management depending on the salt concentration of the irrigation water over 6 years for citrus is illustrated in terms of minimum cost, maximum income, optimum salt concentration of the irrigation water, spatial distribution of average root zone salinity, and the probability of exceeding a prescribed critical soil salinity concentration. (Author's abstract)
W84-02859

3D. Conservation In Domestic and Municipal Use

SIGNIFICANCE OF LOSSES IN WATER DISTRIBUTION SYSTEMS IN INDIA,
National Environmental Engineering Research Inst., Nagpur (India). Environmental Engineering Consultancy Div.
For primary bibliographic entry see Field 5F.
W84-02801

3F. Conservation In Agriculture

REUSE OF WARM WATER ON PAPER MACHINE PAYS OFF AT MADISON,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5D.
W84-02512

CULTIVATION AND EVAPORATIVITY EFFECTS ON THE DRYING PATTERNS OF SANDY LOAM SOIL,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
K. S. Gill, and S. S. Prihar.
Soil Science, Vol. 135, No. 6, p 367-376, June, 1983. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Cultivation, *Evaporation, *Soil water, Drying, Water conservation, Water loss, Evaporativity.

Laboratory and field experiments were conducted to study the influence of the depth of cultivation on: the loss of water from and below the disturbed layer; the cumulative evaporation (CE) and time (t) relationship; and the advance of isohydric fronts into soil, under various evaporativity (Eo) conditions. Cylinders were filled with air-dry (theta = 1 + or - 0.25 g/100 g) sandy loam soil to a bulk density of 1.5 g/cu cm. The columns were wetted from the top with 19 cm of water, allowed to equilibrate for a week, cultivated to depths of 0.6, and 12 cm, and then subjected to drying under evaporativities of 16 (high), 8 (medium), and 4 (low) mm/day. Drying was studied in field plots cultivated to 0, 5, 10, and 15 cm depths when Eo ranged from 1.8 to 4.3 mm/day (average 2.8 mm/day). Cultivation reduced evaporation under all the Eos, with the highest reduction under the low Eo. The maximum evaporation reduction was obtained after 29 days under high Eo and after 55 days under medium and low Eos. The differences in water loss between the 6- and 12-cm cultivation depths were greater under higher Eo. The relationship CE = Kt0.5 gave an excellent fit for both the 6- and 12-cm cultivation treatments under all Eos. The regression coefficient K increased linearly with Eo, and at a given Eo was lower for 12-cm than for 6-cm cultivation. The cultivated layers dried more rapidly than the corresponding depths of uncultivated soil, but the layers below the loosened soil always had more water in cultivated than in uncultivated and in 12-cm than in 6-cm cultivation. The magnitude of differences in soil water across the junction of cultivated layers and the undisturbed soil below was influenced both by cultivation depth and Eo. The position of 0.18 and 0.15 cu cm/cu cm isohydric fronts was always deeper in uncultivated than in cultivated soil, except within the loosened zone. Cultivation after wetting reduces evaporation losses. Much higher soil water content just below the interface with cultivation than in the corresponding depths without cultivation offer potentialities of carrying over soil water in the seed zone during rainless periods. This is possible through shallow cultivation with depth less than the planting depth to conserve water in the seed zone. (Moore-IVI)
W84-02516

INFLUENCE OF CONSERVATION TILLAGE ON SOIL PROPERTIES,
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
R. L. Blevins, M. S. Smith, G. W. Thomas, and W. W. Frye.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 301-305, May-June, 1983. 3 Fig, 5 Tab, 18 Ref.

Descriptors: *Soil water, *Tillage, *Water conservation, Magnesium, Calcium, Nutrients, Nitrogen, Soil permeability, Moisture loss, Moisture stress, Permeability coefficient.

In a long term tillage study, higher soil moisture under no-till crop production was observed as compared with that under conventional tillage throughout the growing season. Under no-till significantly less evaporation occurred in the growing season. This conservation of soil water may carry the no-till crop through short drought periods without severe moisture stress becoming evident in the plants. Under conditions of excess soil water, however, the extra water conserved under no-till can be detrimental and contribute to denitrification losses. There was no problem with soil compaction in no-tillage soils. Better water movement was noted in no-tillage compared with conventional tillage plots as determined by saturated hydraulic conductivity measurements. No deterioration of soil physical properties was noted after 10 years of continuous no-till corn production. Rapid acidification of the soil surface when high nitrogen fertilizer rates were used was the most obvious chemical change. Increased levels of exchangeable aluminum and manganese were associated with reduced soil pH. Exchangeable calcium was significantly lower for no-till at depths and all nitrogen fertilizer rates compared with conventional tillage. Potassium was concentrated in the 0- to 5-centimeter soil layer under no-till and decreased with depth. Exchangeable magnesium in the 0- to 5-cm soil depths declined with increasing nitrogen fertilizer and was lower in no-till soil depth compared with conventional tillage. Organic matter was twice as high in the 0-5 cm soil depth compared to conventional tillage. This modified soil environment affects chemical reactions and the distribution and activity of microbes. (Baker-IVI)
W84-02561

AQUACULTURE STRATEGIES IN CHINA,
New Alchemy Inst., East Falmouth, MA.
R. D. Zweig.
Oceanus, Vol. 26, No. 4, p 33-39, Winter 1983/84. 13 Fig.

Descriptors: *Aquaculture, *China, Yangtze River, Pearl River, Fish farming, Animal wastes, Wastewater, Water reuse, Nutrients.

In parts of China with sufficient freshwater supplies, particularly in the lower reaches of the Pearl and Yangtze river basins, integrated fish farming plays a predominant role in optimizing space and nutrient utilization. Roughly 60% of freshwater fisheries output comes from the Yangtze River Basin with 30% from the Pearl River area. The total freshwater fish production is 10% of the world's output, or a million metric tons a year, half of which is derived from aquaculture. Aquaculture practices in China date back at least 3,000 years. Because of the wide variety of niches in ponds currently being exploited, a broad range of nutrient resources that otherwise have little direct food value to humans can be put into the ponds and used efficiently. Integrated fish farming in China uses fish polyculture in ponds as its predominant activity. Two main fish culture strategies are used: stocking and harvesting in rotation, and multigrade conveyor culture. The combination of fish culture with animal husbandry and agriculture on integrated fish farms increases efficiency through ingenious use of beneficial nutrient subcycles within the farm itself. Some integrated fish farms also produce silk as mulberry plants are grown adjacent to ponds or directly on their dikes. The silkworm feces as well as cocoon-processing wastewater are used as fertilizer for the ponds. (Baker-IVI)
W84-02832

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECT OF THE AQUATIC HERBICIDE ENDOTHAL ON THE CRITICAL THERMAL MAXIMUM OF RED SHINER, NOTROPIS LUTRENSIS,
North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W84-02536

OPERATION OF A PUMPED-STORAGE STATION DURING PASSAGE OF A FLOOD THROUGH THE DAM OF THE LOWER STORAGE RESERVOIR,
A. D. Gulevich.
Hydrotechnical Construction, Vol. 17, No. 5, p 250-252, May, 1983. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 34-35, May, 1983.

Descriptors: *Reservoirs, *Flood control, Floods, Pumped storage, Rivers, Water level, Discharge capacity, Discharge measurement.

The operating conditions of the pumped storage station (PSS) are examined under conditions of an insufficient discharge capacity of the spillway. With the use as the lower reservoir of the PSS of the already existing reservoir of the HES with a turbine discharge Qt and spillway calculated for passage of the maximum river discharge Qf.max-Qt, that is without consideration of the redistribution of the flood discharge, the following operating conditions of the PSS can occur. During discharge of the flood discharge Qf < Qt, the PSS will operate mainly with closed spillway outlets and, consequently, without any restrictions on the operation of the PSS and without a substantial effect of its operation on the river regime below the dam. Under conditions of Qt < Qf < Qf.max-Qo.max (maximum additional discharge), the PSS can operate without restricting its capacity, but there will occur a redistribution of the flood runoff of the river being passed into the lower pool during the day and an increase of the daily variations of the water levels in the river below the dam. For optimal use of the capacity of the PSS and HES it is necessary to coordinate control of the gates of the spillway outlets with the operating regime of the PSS. Under the condition of Qf.max-Qo.max < Qf < Qf.max, the PSS can operate in a turbine regime only with a substantial restriction of the time of its operation and capacity. (Baker-IVI)
W84-02656

SURVIVING THE JOHNSTOWN, PA., FLOOD,
Laurel Management Co., Johnstown, PA.
M. Rosenthal.
Journal of the American Water Works Association, Vol. 75, No. 8, p 390-393, August, 1983. 4 Fig.

Descriptors: *Flood control, *Planning, *Johnstown, *Pennsylvania, *Water supply, Federal jurisdiction, Cost analysis, Power, Management, Floods.

In 1977 a devastating flood in Johnstown, Pa created havoc with the city's water system. Recommendations have been made which should enable a water utility to respond more quickly to the need of supplying safe, potable water in such emergencies. Of the 22,500 households served by the water

authority, 55% are supplied from a gravity system fed by five impounded reservoirs. The remaining half of the customers are served through six separate and totally independent pumping systems. The operating center of this widespread and complex system was flooded by the morning of July 20, when 12 inches of water fell in a 7-8 hr period. To restore temporary service to some totally destroyed areas required more than four weeks. Restoration of service was drastically slowed by the loss of two of five sources of supply. The Laurel Run dam had broken and the supply line of the Saltlick reservoir was washed out in several locations. It is urged that a water utility have on hand an inventory of all other water sources available to the community and data on the quantity, quality and location of each. Alternative sources for industrial and fire-fighting purposes should be identified. Plans should be developed for monitoring water supplies, treatment supplies, and equipment against chemical and biological contaminants. A plan should be formulated to assign major repairs, rebuilding or new construction to certain firms or individuals. A substitute source of power should be identified. A good relationship with federal and state representatives as well as with disaster coordinators enables the utility to obtain assistance promptly. (Baker-IVI)
W84-02667

EFFECTS OF PLEASURE-BOAT TRAFFIC ON MACROPHYTE GROWTH IN CANALS,
Liverpool Univ. (England). Dept. of Botany.
K. J. Murphy, and J. W. Eaton.
Journal of Applied Ecology, Vol. 20, No. 3, p 713-729, December, 1983. 5 Fig, 3 Tab, 63 Ref.

Descriptors: *Boating, *Aquatic plants, *Recreation, *Canals, Turbidity, Aquatic weeds, Aquatic weed control, Canal management, Macrophytes, Plant populations.

The waterways under the control of the British Waterways Board are mostly small, artificial channels, 8-16 m wide and less than 3 m deep. They are divided into Cruising canals for boating, fishing and recreation, and Remainder canals of which many are unnavigable but others have been restored for pleasure-boat navigation. Quantitative surveys of plant growth in British Cruising and Remainder Canals show significant associations between community composition, abundance of aquatic macrophytes and pleasure-boat traffic. Cluster analysis revealed four principal groupings of sites, which had significantly different mean boat traffic densities and markedly different macrophyte community compositions and abundances. Maximum-likelihood and regression analysis indicated significant inverse relationships between total, emergent and submerged macrophyte community abundance and boat traffic. Evidence was found for a 'critical' traffic range, about 2000-4000 movements/ha/m depth/year (my), reducing submerged macrophyte standing crop, perhaps by maintaining high daytime water turbidity, during the summer months as there were significant associations between boat traffic density, water turbidity and summer submerged crop. The seasonal distribution of pleasure-boat traffic appeared to be an important influence on submerged macrophyte community abundance. The course of macrophyte community development may be largely determined by the stage in the growth season at which traffic in the range 300-600 movements/ha/m depth/(4 weeks) is attained. Relationships between the abundance of emergent plants and boat traffic were weaker, and there was no significant association with water turbidity. In 1977 approximately 50% of the canal system carried low pleasure-boat traffic density (<2000 my), 24% had traffic within the critical range (2000-4000 my), and 26% had heavy traffic (>4000 my). Canals with no, or very low, boat traffic suffer growths of macrophytes sufficient to impair navigation, angling and water flow. Traffic in the range 100-200 my seems to create a satisfactory balance between ecological and other features of canals. The boats then suppress macrophyte abundance sufficiently to arrest vegetation encroachment, usually without unduly damaging plant community diversity. (Moore-IVI)
W84-02680

THE ECONOMICS OF IRRIGATION WITH NONUNIFORM INFILTRATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
E. Feinerman, J. Letey, and H. J. Vaux, Jr.
Water Resources Research, Vol. 19, No. 6, p 1410-1414, December, 1983. 6 Fig, 14 Ref. California Water Resource Control Board contract 2-043-300-0.

Descriptors: *Infiltration, *Irrigation water, *Economic aspects, Crop yield, Water costs, Hydrologic models, Crop yield, Water use.

Economic implications of nonuniform water infiltration in irrigated fields can be assessed with a simplified hydrologic balance model linked to an economic optimization model through a crop water production function. The effects of nonuniformity are derived by using two production functions that differ in terms of the sensitivity of yield to applications of water greater than that needed to achieve maximum yield. Where crop yield is sensitive to excess water, productivity and optimal levels of water application are lower in nonuniform fields than in uniform fields. If crop yield is not sensitive to excess water, outcomes depend on the price of water relative to crop income net of water costs. The conclusions, then, depend crucially on the form of the production function. An example is used to demonstrate that irrigation technology and management that increases the uniformity of infiltration may increase both productivity and the levels of agricultural water use. (Author's abstract)
W84-02844

REAL-TIME FORECASTING AND DAILY OPERATION OF A MULTIRESERVOIR SYSTEM DURING FLOODS BY LINEAR QUADRATIC GAUSSIAN CONTROL,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
S. A. Wasimi, and P. K. Kitanidis.
Water Resources Research, Vol. 19, No. 6, p 1511-1522, December, 1983. 11 Fig, 1 Tab, 55 Ref. DOI grants A-077-IA and A-0380IA, NSF grant CEE-8212066.

Descriptors: *Reservoir operation, *Multireservoir networks, *Floods, Flood damage, Mathematical models, Flood forecasting, River forecasting, Storm runoff, Flood routing.

The problem of short-term (daily) operation of a multireservoir system during floods is examined. The problem is how to use all available real-time information to solve the 'tactical' problem of regulating reservoirs to minimize the expected value of flood damage during a relatively short operating horizon and to do so consistently with the long-term operating strategy. A state-space mathematical model is presented for short-term forecasting of river flows and description of the dynamics of a multireservoir system. The model includes reduced-order state-space unit hydrographs to forecast storm runoff from effective rainfall and state-space representations of linear flood routing. The optimization problem is solved in the framework of discrete-time linear quadratic Gaussian (LQG) control. LQG control is a computationally efficient and flexible method of solving the large-dimensional optimization problems associated with the solution of the tactical problem of short-term operation of reservoirs. For application of the LQG control methodology the system must be represented in state-space form with quadratic cost functions subject to linear equality constraints given by the state transition equations. The scheme was found to be suitable for operation under moderate flood conditions when capacity constraints are not likely to become binding. The methodology has been applied and tested in a real-world case. (Author's abstract)
W84-02853

A KINEMATIC MODEL FOR SURFACE IRRIGATION: VERIFICATION BY EXPERIMENTAL DATA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and R. S. Ram.
Water Resources Research, Vol. 19, No. 6, p 1599-1612, December, 1983. 14 Fig, 7 Tab, 36 Ref. NSF project NSF-ENG-79-23345.

Descriptors: *Kinematic models, *Surface irrigation, Water surface profile, Recession times, Advance times, Mathematical models.

A kinematic model for surface irrigation is verified by experimental data obtained for 31 borders. These borders are of varied characteristics. Calculated values of advance times, water surface profiles when water reaches the end of the border, and recession times are compared with their observations. The prediction error in most cases remains below 20% for the advance time and below 15% for the recession time. The water surface profiles computed by the model agree with observed profiles reasonably well. For the data analyzed here the kinematic wave model is found to be sufficiently accurate for modeling the entire irrigation cycle except for the vertical recession. (Author's abstract)
W84-02858

RELIABILITY CONSTRAINED RESERVOIR CONTROL PROBLEMS; 2. RANDOMIZED STRATEGIES,
National Research Inst. for Mathematical Sciences, Pretoria (South Africa).
M. Sniedovich, and P. A. Nielsen.
Water Resources Research, Vol. 19, No. 6, p 1622-1626, December, 1983. 1 Fig, 11 Ref.

Descriptors: *Reservoir operation, *Randomized strategies, Reservoir releases, Stochastic process, Heuristic methods.

The structure of release strategies is an important element in the analysis and optimization of reservoir control problems, particularly in stochastic problems. Despite the clear advantages that randomized strategies offer over pure strategies in reliability-constrained reservoir control problems, their use appears limited if one adopts a purely frequency-based approach to probability. This observation is valid for both versions of mixed strategies, although mixing in advance seems to be, at least superficially, more difficult to implement. From the mathematical point of view, mixed strategies can be instrumental in providing upper bounds for heuristic methods designed to generate pure strategies. It is essential to specify which type of randomized strategy is being considered, and to ensure that the solution procedure used does yield randomized strategies for the type specified. Even if they are not actually implemented, the construction of randomized strategies can play an important role in the process of developing good heuristic pure strategies. It does not appear likely that water resources planners will accept these types of strategies because of the frequency-based approach to probability which is commonly used to interpret probabilistic constructs in the water resources context. (Moore-IVI)
W84-02860

INFLOW STOCHASTIC MODELS FOR THE MANAGEMENT OF RESERVOIR SECONDARY YIELDS,
Naples Univ. (Italy). Ist. Elettrotechnico.
G. Ambrosino, G. Fronza, and F. Garofalo.
Journal of Hydrology, Vol. 67, No. 1-4, p 77-95, 1984. 9 Fig, 2 Tab, 7 Ref, 2 Append.

Descriptors: *Reservoir operation, *Firm yield, *Secondary yield, Stochastic methods, Mathematical models, Computer models, Simulation, Lake Maggiore, Italy.

Firm yield from a reservoir can be defined as the flow-rate guaranteed to downstream users, with a given probability. In addition to such requirements there are often secondary needs, which are satisfied or not according to the decision-maker's subjective judgement in the various hydrologic situations. A rather general approach is presented for optimizing the release of these secondary yields, while keeping the primary deficits (deficits corresponding to releases less than firm yield) at their

minimum possible value. This is accomplished by an optimization model (mathematical program), minimizing the overall primary deficit. The program has multiple optimal solutions, among which one is chosen by another mathematical program, maximizing the overall secondary benefit. This final 'solution' of the two mathematical programs is derived explicitly in the form of an optimal time varying operating rule. Since the actual implementation of the rule would require knowledge of all future inflows at each time step, a heuristic modification is introduced. At each time step, future is divided into two parts: next future, which is taken into account by introducing a forecast of its inflows into the procedure, and far, unpredictable future, which is taken into account by a severe 'safety constraint' on its primary deficits. By computer simulation, the management procedure was applied to the hydrologic and water requirement data from Lake Maggiore, in the north of Italy. The simulation of the management procedure was carried out for the period 1947-1966. (Moore-IVI)
W84-02887

RESERVOIR OPERATION: CHOICE OF OBJECTIVE FUNCTIONS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. Mohammadi, and M. A. Marino.
Journal of Water Resources Planning and Management, Vol. 110, No. 1, p 15-24, January, 1984. 4 Fig, 5 Tab, 13 Ref. CSRS project CA-D*-LAW-4116-H.

Descriptors: *Reservoir operation, *Objective function, Algorithms, Computers, Computer programs, Computer models, Water management, Optimization, Mathematical models, Multiobjective planning, Multipurpose reservoirs.

An efficient algorithm for the real-time monthly operation of a multipurpose reservoir is a combination of linear programming (used for month-by-month optimization) and dynamic programming (used for annual optimization). Parametric linear programming, minimum required beginning-of-month storages, and an iterative solution procedure result in low computer time and computer storage requirements. Low computer storage requirements allow the model to be run on minicomputers. The model is general enough to be applied to any multipurpose reservoir, such as, water and energy maximization, water and energy maximization with flood control considerations, and water and energy maximization for peak demand months are considered. Thus, the model provides the reservoir operator with different choices for annual optimization. The model is applied to Folsom reservoir of the California Central Valley Project. (Murphy-IVI)
W84-02918

AGRICULTURAL WATER RESOURCES MANAGEMENT IN INDIA,
CH2M Hill, Inc., Gainesville, FL.
U. P. Singh.
Journal of Water Resources Planning and Management, Vol. 110, No. 1, p 30-38, January, 1984. 2 Fig, 12 Ref.

Descriptors: *Agricultural hydrology, *Water management, *India, Irrigation, Irrigation effects, Water table rise, Drainage, Soil conservation.

Agriculture still forms the backbone of India's economy, accounting for almost half of the national income and providing employment to about two-thirds of the work force. Accordingly, the greatest use of water resources has been for agricultural development, which would have benefited considerably by improvements in the management of water resources. Some of the challenges in agricultural development are delivery of water for irrigation, rising water tables, water-logging and severely impeded drainage, increasing soil salinity, soil conservation practices, traditional irrigation practices, size of land holdings, limited research and agricultural extension work, marketing problems and unavailability of modern technology to Indian farmers on economically attractive terms. (Murphy-IVI)
W84-02919

MULTIOBJECTIVE WATER RESOURCES MANAGEMENT PLANNING,
California Univ., Los Angeles. School of Engineering and Applied Science.
P. W. F. Louie, W. W.-G. Yeh, and N.-S. Hsu.
Journal of Water Resources Planning and Management, Vol. 110, No. 1, p 39-56, January, 1984. 8 Fig, 4 Tab, 20 Ref. UCWRC project UCAL-WRC-W-576.

Descriptors: *Multiobjective planning, *Water management, Optimum development plans, Optimization, Water supply, Water supply development, Water quality, Water quality management, Overdraft, Model studies.

A multiobjective optimization procedure using the constraint linear programming technique assists water resource planners to establish a more unified basin-wide management plan which will simultaneously consider the three major aspects in basin-wide planning: (1) water supply allocation; (2) water quality control; and (3) prevention of undesirable overdraft of the ground-water basin. This optimization procedure is designed to be applied in concert with one or more simulation models: a ground-water quantity-and-quality model or a river flow-and-mass transport model, or both, and a model which routes the water from the supply sources to various demand points, through the wastewater collection and treatment facilities, and ultimately to the disposal sites. The influence coefficient method, used as the connecting agent, creates the necessary linkage between the optimization procedure and the simulation models. With this agent, the optimization procedure can be carried out independently of the simulation models, while, at the same time, keeping a good representation of the response surface of the simulation models in the optimization procedure. (Murphy-IVI)
W84-02920

IRRIGATION WATER DELIVERY FOR EQUITY BETWEEN USERS,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
A. A. Bishop, and A. K. Long.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 349-356, December, 1983. 1 Fig, 2 Tab.

Descriptors: *Irrigation, *Planning, Decision making, Water management, Water demand, Water supply.

Usually one of three delivery systems is adopted to obtain equity between users: demand, continuous flow, and rotation. The demand method is perhaps the most sophisticated, consisting of making water delivery to the farmer's field upon receiving orders from him specifying the time and amount. The continuous flow method consists of delivering water to each user on a continuous basis. The rotation delivery method is perhaps the most widely used, consisting of providing each user of a common farm ditch the exclusive use of the water for a specified period of time. A procedure for designing a rotating delivery schedule is outlined. To be equitable among users, water deliveries should provide an equal volume of water per unit of land irrigated. The time of day should be alternated so that irrigators share the advantages and disadvantages. The losses of the system including seepage, administration, and time should be apportioned so that no water user has more than his share. (Baker-IVI)
W84-02923

KINEMATIC-WAVE FURROW IRRIGATION MODEL,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
W. R. Walker, and A. S. Humpherys.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 377-392, December, 1983. 10 Fig, 2 Tab, 22 Ref. UAES project AES 799.

Descriptors: *Kinematic-wave furrow irrigation model, Model studies, Mathematical models, Surface irrigation, Furrow irrigation, Irrigation efficiency, Surface flow, Flow profiles,.

For a kinematic-wave model of furrow irrigation under both continuous and surged flow management the numerical solution of the differential continuity equation is accomplished with a Eulerian first-order integration coupled with the assumption that flow rate and flow area are uniquely related by the Manning uniform flow equation. Field data from three Colorado sites, a Utah site, and an Idaho site verify the model's continuous flow simulation of advance and recession. The sites represented a wide range of soil types, field slopes and lengths, and duration of the irrigation event. Companion data from the Utah and Idaho sites verified the model's analysis of surge flow conditions. (Murphy-IVI)
W84-02926

MODELING WATER DEMANDS OF IRRIGATION PROJECTS,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and P. D. Hutchinson.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 405-418, December, 1983. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Model studies, *Water demand, *Irrigation programs, Irrigation design, Project planning, Agricultural hydrology, New Zealand.

A simulation model for assessing the water demands of large irrigation areas is applied to the mid-Canterbury region of New Zealand. Observations from historical water use patterns provide a basis for demand modeling using simplified irrigation watering, strategies, highlighting climatic time variability as the single most important influencing factor. Per unit area irrigation demands are first estimated for each identified unique combination of soil, crop type and irrigation strategy using daily soil moisture balance simulation over a number of seasons of recorded climate data. These are then combined using crop areas and efficiency weights to give time patterns of areally-aggregated water demand. The model is checked against field trial data, calibrated against water use in an existing irrigation scheme, and applied to demand estimation for a large proposed future project. (Murphy-IVI)
W84-02927

4B. Groundwater Management

DEVELOPMENT OF GROUNDWATER RESOURCES OF SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
I. Ali.
Proceedings of the Institution of Civil Engineers, Vol. 74, Part 1, p 885-898, November, 1983. 2 Fig, 5 Tab, 37 Ref.

Descriptors: *Groundwater resources, *Saudi Arabia, Desalination, Sea water, Artesian springs, Wells, Aquifers, Irrigation, Water supply development, Water reuse.

The Kingdom of Saudi Arabia extends over an area of some 2,177,400 sq km, covering four fifths of the Arabian peninsula. Rainfall in the northern two thirds is scanty, unpredictable and irregular. No rivers or surface waters exist within the kingdom. A number of valleys called wadis, exist which drain the runoff. About 42 dams have been built to increase the groundwater recharge in these wadis. The other major source is sea water with costly desalination. Recycling of sewage is under consideration. The kingdom can be divided into two distinct regions. One third of the total area contains igneous rocks while the remainder consists of sedimentary rocks. Igneous rocks contain little water. Sedimentary rocks contain the aquifers, 11 of which are the main groundwater sources. At present groundwater resources have been and are being investigated, developed, used and managed on the basin concept. During the five years from 1975-1980, 575 wells were drilled and 900 wells are planned for the period 1980-85. The total dissolved solids of groundwater as shown vary greatly from 400 ppm to 36000 ppm. Successful utilization will depend on the purpose for

which the water is used. The use of brackish water for agriculture and drinking within economic limits is a great challenge for the engineers in Saudi Arabia. A large quantity of the groundwater stored in deep aquifers has been estimated to be 25,000 to 30,000 years old and is mainly fossil water with little or no recharge. Care is needed in its use, so as to save it for future generations. (Baker-IVI)
W84-02508

OPTIMAL GROUNDWATER DEPLETION WITH INTERDEPENDENT NONRENEWABLE AND RENEWABLE RESOURCES,
Oklahoma Univ., Norman. Div. of Economics.
M. J. Mueller.
Water Resources Research, Vol. 19, No. 5, p 1091-1098, October 1983. 1 Fig, 20 Ref.

Descriptors: *Water allocation, *Groundwater depletion, *Resource development, Oil industry, Agriculture, Water demand, Optimization, Economic models, Ogallala Aquifer, Costs, Policy making.

An economic model was developed for the optimal use of a nonrenewable resource, groundwater from a nonrecharging aquifer, which is used as an input in the production of a nonrenewable and a renewable resource, petroleum and agricultural crops. The model is based on the Ogallala Aquifer, which has such a small recharge rate that its water can be considered a nonrenewable resource. The two principle activities of the region are agriculture and petroleum production. The problem of optimal use is analyzed using a linear allocation parameter, nonlinear cost functions, and optimal control techniques. The analysis can be useful in policy questions at two levels. First, estimation of the parameters of the total cost functions, plus knowledge of the current rate of production of petroleum and agricultural output, provides the information necessary to determine the value of the allocation parameter. Knowledge of its value would inform policy makers so that they could establish priorities between the two sectors for groundwater use. Alternatively, it would help in establishing and administering regulations so that access to groundwater is not restricted in favor of another sector. (Moore-IVI)
W84-02754

CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER FOR IRRIGATED AGRICULTURE: RISK AVERSION,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. D. Bredehoeft, and R. A. Young.
Water Resources Research, Vol. 19, No. 5, p 1111-1121, October, 1983. 16 Fig, 7 Tab, 8 Ref.

Descriptors: *Conjunctive use, *Well capacity, *Irrigation water, *Groundwater pumping capacity, *Economic aspects, South Platte Valley, Colorado, Simulation, Flow augmentation, Water supply development, Low flow.

In the South Platte system in Colorado where surface water and groundwater are used conjunctively for irrigation, the actual installed well capacity is approximately sufficient to irrigate the entire area. This would appear to be an overinvestment in well capacity. The extent to which groundwater is being developed as insurance against periods of low streamflow is examined, using a simulation model which couples the hydrology of a conjunctive stream aquifer system to a behavioral-economic model which incorporates farmer behavior in such a system. The area modeled is patterned after a reach of the South Platte Valley in Colorado. Under current economic conditions the most reasonable groundwater pumping capacity is a total capacity capable of irrigating the available acreage with groundwater. Installing sufficient well capacity to irrigate all available acreage has two benefits: this capacity maximizes the expected net benefits and this capacity also minimizes the variation in annual income - it reduces the variance to essentially zero. The present Colorado plan of 5% flow augmentation may be small in really dry years. An augmentation capacity approaching 10% may be necessary in dry years such as occurred from 1953 to 1956. As pumping capacity is installed in a conjunctive use system, the value of flow forecasts is diminished. Poor forecasts are compensated for by pumping groundwater. It is questionable in systems such as the South Platte with a large installed well capacity for most of the area that one should spend much effort on improving flow forecasts for water supply purposes. (Moore-IVI)
W84-02756

DISTRIBUTED PARAMETER MODELING OF A PRODUCING VAPOR-DOMINATED GEOTHERMAL RESERVOIR: SERRAZZANO, ITALY,
California Univ., Berkeley. Lawrence Berkeley Lab.
K. Pruess, O. Weres, and R. Schroeder.
Water Resources Research, Vol. 19, No. 5, p 1219-1230, October, 1983. 12 Fig, 6 Tab, 25 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Geothermal resources, *Mathematical models, *Serrazzano, *Italy, Geothermal studies, Simulation, Computer models, Steam, Boiling, Pressure, Aquifers, Groundwater recharge, Thermal equilibration, Geohydrology, Injection wells, Condensates.

The simulator SHAFT79 of Lawrence Berkeley Laboratory was applied to a field-wide distributed parameter simulation of the vapor-dominated geothermal reservoir at Serrazzano, Italy. Using a three-dimensional geologically accurate mesh and detailed flow rate data from 19 producing wells, a period of 15.5 years (from 1959 to 1975) was simulated. The reservoir model used is based on field measurements of temperatures and pressures, laboratory data for core samples, and available geological and hydrological information. The main parameters determined (adjusted) during development of the simulation are permeabilities and much of the initial conditions. Simulated patterns of pressure decline show semiquantitative agreement with field observations. Field pressure declined overall somewhat more rapidly than predicted in the simulation. The interface between overlying steam cap and deeper boiling aquifer remains stationary during exploitation and the aquifer boils approximately uniformly throughout in response to production. Some steam flowing to the main well field may originate from deep fractures rather than from boiling in the two-phase zones modeled. Effects of cold recharge, incomplete thermal equilibration between rock and fluid, and different assumptions regarding the depth of the steam/two-phase interface were investigated. Either a diminished volume of the two-phase zone or incomplete thermal equilibration between rock and fluid could very significantly increase the rate of temperature and pressure decline. These two effects could separately or together account for an additional temperature decline of 5-6 C over the simulated period of 15.5 years, which is required to make the simulated average pressure decline agree with the value deduced from field data. The reservoir model is used to extrapolate (forecast) production rates on a well-by-well basis through 1990. Injection of spent condensate is expected to have negligible impact on field performance. (Moore-IVI)
W84-02765

PREDICTION AND ANALYSIS OF A FIELD EXPERIMENT ON A MULTILAYERED AQUIFER THERMAL ENERGY STORAGE SYSTEM WITH STRONG BUOYANCY FLOW,
California Univ., Berkeley. Lawrence Berkeley Lab.
T. A. Buscheck, C. Doughty, and C. F. Tsang.
Water Resources Research, Vol. 19, No. 5, p 1307-1315, October, 1983. 22 Fig, 5 Tab, 18 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Thermal energy storage, *Buoyancy flow, *Storage aquifers, *Multilayered aquifers, Water temperature, Mathematical models, Groundwater movement, Mobile, Alabama.

Seasonal aquifer thermal energy storage field experiments were conducted near Mobile, Alabama in 1981-1982. During the first cycle, 25,000 cu m of water at an average temperature of 59 C was injected over a period of 1 mo., stored for 1 mo. and then produced. In the second cycle, a total of 58,000 cu m of water at an average temperature of 82 C was injected over a period of 4.5 mo., then stored for one month and withdrawn. The results of the first two cycles were predicted by numerical modeling before their conclusion with good accuracy. Subsequent comparison of experimental and calculated results provided important insight into areas of model improvement and alternative experimental design. Key factors influencing energy recovery appear to be aquifer heterogeneity (layering) and strong buoyancy flow in the aquifer. Both field temperature measurements and numerical modeling results indicate that hot water movement in this system is strongly influenced by layering and buoyancy flow. Whlie aquifer layering decreases the energy recovery factor by a moderate amount for both cycles, the larger buoyancy flow associated with the high injection temperature of the second cycle is a dominant influence on recovery factor. In general, both are important factors in the estimation of the feasibility of an aquifer thermal energy storage system. An optimization study based on second-cycle conditions calculated a series of scenarios, each using a different injection and production scheme, to study possible ways to improve energy recovery. The results of this optimization study were used in the design of the third-cycle experiment. (Moore-IVI)
W84-02770

USES OF NUMERICAL MODELING IN THE DESIGN AND LICENSING OF DEWATERING AND DEPRESSURIZING SYSTEMS,
Stone and Webster Engineering Corp., Cherry Hill, NJ.
E. S. Bair, and T. P. O'Donnell.
Ground Water, Vol. 21, No. 4, p 411-420, July-August, 1983. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Dewatering, *Depressurizing, *Construction, *Mathematical models, Hydraulic head, Pumping, Water table aquifers, Simulation, Groundwater movement, Drawdown, Drainage wells, Licenses, Hydraulic gradient.

Numerical models can be used to aid in the design and licensing of dewatering and depressurizing systems by simulating changes in hydraulic head produced by the interference patterns of various configurations and pumping rates of wells, wellpoints, or ejectors. The total quantity of water that must be pumped to achieve the desired objective can be approximated by modeling the inflow rate into a network of constant-head nodes located around the perimeter of an excavation and assigning a hydraulic-head value to these nodes equivalent to the average level to which the water table or potentiometric surface would be lowered by a dewatering or depressurizing system. As a result, it is possible to determine the decrease in the inflow rate as the flow system goes from the period of transient flow, when significant quantities of water are released from storage in unconfined aquifers and hydraulic gradients are steeper, to the period of steady-state flow when no water is released from storage and hydraulic gradients are flatter. Based on the inflow rate data, simulations can be made showing the effectiveness of various pumping well configurations. In these simulations, the number, location, and pumping rates of wells can be varied to design a dewatering or depressurizing system that maximizes well interference and drawdown with a minimum number of wells. Decreases in the inflow rate during transient flow can be accounted for by adjusting well discharge rates during the transient flow period. Simulation results can be used to determine the radius of influence of the system, calculate induced drawdown in nearby wells, determine the amount of time required for predrainage prior to construction, calculate the amount of induced infiltration from nearby surface-water bodies, evaluate the need for contingency wells, and evaluate whether undesirable fluids will be induced to flow toward the excavation. (Author's abstract)
W84-02802

REGIONAL MANAGEMENT OF AN AQUIFER FOR MINING UNDER FUZZY ENVIRONMENTAL OBJECTIVES,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
I. Bogardi, A. Bardossy, and L. Duckstein.
Water Resources Research, Vol. 19, No. 6, p 1394-1402, December, 1983. 5 Fig, 8 Tab, 39 Ref. NSF grants INT 78-12184 and CEE 8110448.

Descriptors: *Fuzzy set analysis, *Mining, *Aquifer management, Bauxite, Hungary, Dewatering, Grouting, Thermal springs, Mathematical models, Groundwater recharge, Karst hydrology, Costs.

A methodology is developed for the dynamic multiobjective management of a multipurpose regional aquifer. In a case study of bauxite mining in Western Hungary, ore deposits are often under the piezometric level of a karstic aquifer, while this same aquifer also provides recharge flows for thermal springs. N + 1 objectives are to be minimized, the first one being total discounted cost of control by dewatering or grouting; the other N objectives consist of the flow of thermal springs at N control points. However, there is no agreement among experts as to a set of numerical values that would constitute a 'sound environment'; for this reason a fuzzy set analysis is used, and the N environmental objectives are combined into a single fuzzy membership function. The constraints include ore availability, various capacities, and the state transition functions that describes the behavior of both piezometric head and underground flow. The model is linearized and solved as a biobjective dynamic program by using multiobjective compromise programming. A numerical example with N = 2 appears to lead to realistic control policies. Extension of the model to the nonlinear case is discussed. (Author's abstract)
W84-02842

GROUND-WATER MANAGEMENT IN WESTERN KANSAS,
Southwest Kansas Groundwater Management District No. 3, Garden City.
E. D. Jenkins.
Journal of Hydraulic Engineering, Vol. 109, No. 10, p 1314-1322, October, 1983. 3 Fig, 1 Tab, 6 Ref.

Descriptors: *Groundwater management, *Kansas, *Ogallala aquifer, Groundwater depletion, Well spacing, Safe yield, Groundwater mining.

Western Kansas includes an area of 25,000 sq mi and has a semiarid climate. It is underlain by the Ogallala aquifer, which produces water of good quality. Many large-capacity wells have been drilled for irrigation, industrial, and municipal use. Groundwater withdrawals exceed recharge and water levels are declining at an average rate of 3 ft/yr. Water rights in Kansas are considered as property rights and can be bought or transferred to another beneficial use. In 1972, the Kansas Legislature passed the Kansas Groundwater Act authorizing the formation of local groundwater management districts to help control and direct the development and use of groundwater resources. Five groundwater management districts were formed of which the four western districts overlie parts of the Ogallala aquifer. Each district has its own distinct management plan; their ultimate goals are to conserve and prolong the life of the aquifer. Management policies that have the most effect on withdrawals are well spacing and a planned rate of ground-water depletion. The three western districts (1, 3, and 4) have the greatest number of large capacity wells and the highest rate of water level decline, but the least precipitation. Each of these districts has adopted a plan that will allow a portion of the aquifer to be depleted over a period of 20-25 yr. The districts to the east (2 and 5) are not as heavily developed and have more precipitation. These districts have adopted a safe yield management plan. (Moore-IVI)
W84-02866

CONSERVATIVE ESTIMATION OF GROUNDWATER VOLUMES: APPLICATION OF LINEAR PROGRAMMING TO TRITIUM DATA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol. 67, No. 1-4, p 183-193, 1984. 4 Fig, 3 Ref.

Descriptors: *Groundwater management, *Linear programming, Systems analysis, Decision making, Management, Water resources development, Water management.

Linear programming minimization is a simple conservative course of action when there is insufficient information for direct estimation of the mean transit time (turnover time) by a parametric model. Alternatively, available information may not be in a form suitable for incorporation into a parametric model. For example, if it was felt that something like the classical highly peaked piston-flow model was appropriate, then this could be defined by the single constraint of an upper bound to the mean deviation of exit-age distribution. In this case, the minimum mean transit time and specific exit age distribution near the region of best fit are unlikely to be greatly different from any parametric equivalents. Even so, the linear programming procedure is very much a pragmatic technique, limited to obtaining minimum values of turnover time and groundwater volumes. More detailed aspects of aquifer hydrology are best dealt with in the framework of parametric modelling. (Baker-IVI)
W84-02893

SECONDARY RECOVERY OF WATER,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
B. J. Claborn.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 4, p 357-365, December, 1983. 8 Fig, 7 Ref.

Descriptors: *Secondary water recovery, Injection, Vadose water, Estimated costs, Water level, Interstitial water.

Injection of air into the vadose zone has made water available for recovery by conventional means at two test sites on the High Plains of Texas. The cost of this water, exclusive of research costs, is estimated to be about $50 per acre-ft. Large quantities of water may be available for recovery in aquifers which have experienced long term water level declines, and where a layer of low permeability material is available to prevent rapid escape of the injected air. A possible explanation of the mechanism of removal is that movement occurs because of unbalanced pressure forces on the capillary water. These forces are caused by the flow of the injected air past the pore water. (Murphy-IVI)
W84-02924

4C. Effects On Water Of Man's Non-Water Activities

IRAN'S MODE OF MODERNIZATION: GREENING THE DESERT, DESERTING THE GREENERY,
H. Pazwash.
Civil Engineering, Vol. 53, No. 3, p 48-51, 1983. 2 Fig.

Descriptors: *Aqueducts, *Water conveyance, *Qanats, Iran, Irrigation, Deserts, Arid lands, Water supply development, Groundwater, History.

The history of providing water for irrigation and agricultural purposes in the largely desert country of Iran is considered. Many centuries ago well digging, which had been a primitive means to reach groundwater, was gradually developed into the art of qanat construction. The qanat construction technology is similar to tunneling, but it is more involved and requires a basic understanding of groundwater flow in addition to an accurate surveying and adequate precautions for ventilation and for prevention of collapse in soft soils. Qanats collect fresh groundwater from rich aquifers in mountain slopes, which receive more rain than plains (kavirs) and which absorb a major portion of runoff by infiltration. Through them water is brought from mountain slope aquifers to the center of kavirs, where the groundwater is generally stagnant and often saline. Through construction of qanats, sufficient water was provided to permit adequate irrigation as well as to supply domestic needs in many parts of the Persian plateau. Qanats are also cheaper than wells in providing water to the area in that they do not require the constant upkeep and maintenance which wells often do. Figures indicate that a qanat, on the average, pays off in a period of 30 years, although it gives service for centuries, once it is constructed. Recent changes in Iran through the Land Reform Act have caused the large parcels of land owned by individuals to be divided among many farmers. The upkeep of qanats and conveyance channels was not continued as more and more of the farmers left the farms and headed for the cities. Many farmers drilled new wells where they had previously relied on qanat water. The excessive drawdowns of most of the deep wells rendered many qanats dry and unproductive, causing more farmers to desert their fields. The construction of large dams has also had an impact on the qanat water availability. Poor planning resulted in many errors, leading to the present conditions where about 11% of the available land is in greenery as compared to 28-30% some 20 yeas ago. (Baker-FRC)
W84-02553

NONPOINT WATER QUALITY CONTRIBUTIONS FROM LAND USE,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 5B.
W84-02683

HYPOTHESIS-TESTING BY MODELLING CATCHMENT RESPONSE,
Hull Univ. (England). Dept. of Geography.
R. C. Ward.
Journal of Hydrology, Vol. 67, No. 1-4, p 281-305, 1984. 9 Fig, 1 Tab, 14 Ref. NERC grants GR3/2543 and GR3/3348.

Descriptors: *Model studies, *Catchment areas, Artificial precipitation, Evapotranspiration, Streamflow, Soil water, Model testing, Computer models.

A hydrologically rigorous process-based catchment model in which the empirical component is minimal consists of precipitation and potential evapotranspiration; output consists of hourly or daily values of actual evapotranspiration, soil-moisture status and streamflow. Detailed comparisons of observed and modelled streamflow and soil-moisture status indicate that in its present preliminary form the model generates hydrologically plausible output data although specific improvements are suggested by an analysis of the major discrepancies between observed and modelled streamflow. (Murphy-IVI)
W84-02899

4D. Watershed Protection

OPTIMAL OPERATION OF MULTIPURPOSE POOL OF ELK CITY LAKE,
Indiana Dept. of Highways, Indianapolis.
S. Esmaeil-Beik, and Y.-S. Yu.
Journal of Water Resources Planning and Management, Vol. 110, No. 1, p 1-14, January, 1984. 6 Fig, 5 Tab, 18 Ref. USDI project B-053-KAN.

Descriptors: *Optimum development plans, *Multipurpose pool, *Elk City Lake, Reservoir Operation, Model studies, Water loss, Stochastic process.

A stochastic dynamic programming develops optimal policies for operating the multipurpose pool of the Elk City Lake in Kansas with serially correlated inflows. The model determines a long-term operating policy to minimize the expected average annual loss. Using the developed optimal policy to

operate the lake from 1967 to 1977 shows a marked reduction in the expected annual losses as compared with the historical operation. (Murphy-IVI)
W84-02917

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

THE INFLUENCE OF THE DISSOLVED OXYGEN CONCENTRATION ON THE PHYSIOLOGY AND ECOLOGY OF SPHAEROTILUS NATANS KUTZ,
Eidgenoessische Materialpruefungs- und Versuchsanstalt, Sankt Gallen (Switzerland).
K. Mechsner.
Oecologia, Vol. 60, No. 1, p 18-20, 1983. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Dissolved oxygen, *Sphaerotilus, *Metabolism, Bioindicators, Aerobic conditions, Anaerobic conditions, Fermentation.

Sphaerotilus natans, one of the most important indicator organisms for polluted water, assumes a substantial ecological significance by causing a nuisance by its frequent mass development in polluted natural waters and sewage treatment plants. Using a hermetically closed experimental system the influence of continuously decreasing oxygen concentration on the metabolism of S. natans was investigated by concurrently measuring the temperature, pH, oxygen, sucrose, organic acids, diluted organic carbon (DOC) and dry weight. Oxygen and sucrose were eliminated linearly until the detection limit of <0.1 mg O2/l for dissolved oxygen concentration was reached. Under anaerobic conditions neither sucrose, uptake nor organic acid formation occurred and and autolytic processes were evident. The results confirm that Sphaerotilus natans is an aerobic organism with no capacity for fermentative metabolism. (Moore-IVI)
W84-02494

SEDIMENT BIOASSAYS WITH OYSTER LARVAE,
E.V.S. Consultants Ltd., North Vancouver (British Columbia).
P. M. Chapman, and J. D. Morgan.
Bulletin of Environmental Contamination and Toxicology, Vol 31, No. 4, p 438-444, 1983. 1 Tab, 13 Ref.

Descriptors: *Sediments, *Bioassays, *Oysters, *Toxicity, Puget Sound, Washington, Larval growth stages, Development, Mortality.

A simple methodology is presented for undertaking sediment bioassays with oyster larvae, and data are presented to prove the utility of this method. Test sediments were collected from a total of 22 stations in Puget Sound, Washington, generally from areas with high levels of chemical contamination. Control cultures showed extremely low percentages of abnormal larvae (1.1-1.6%). Sediment samples gave dramatic differences in responses ranging from extremely toxic to non-toxic. No live larvae were found after 48 hr in the assay for one station, considered to be the most toxic. Survival values generally agreed with the data on abnormalities. Of the 22 stations tested, 13 were highly toxic to oyster larvae, 5 stations were moderately toxic, and 4 were non-toxic. The development of larval abnormalities in combination with mortality served as an indication of chemical toxicity in tested sedients. The methodology uses higher sediment concentrations than most other studies without problems from physical abrasion, has been shown to work, and provides data comparable to other toxicity tests. (Moore-IVI)
W84-02531

CONFIRMATION OF WATER QUALITY MODELS,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow, and S. C. Chapra.
Ecological Modelling, Vol. 20, No. 2/3, p 113-133, November, 1983. 8 Fig, 1 Tab, 52 Ref.

Descriptors: *Water quality, *Model studies, *Simulation, Statistical analysis, Mathematical models.

Water quality simulation models, whether descriptive or predictive, must undergo confirmatory analyses if inferences drawn from the models are to be meaningful. Current practices in the confirmation of simulation models are examined and criticized from this perspective. In particular, labeling this process 'verification' or 'validation' (truth) probably contributes to the often inadequate efforts, since these states are unattainable. The evaluation of scientific hypotheses, or water quality simulation models, may proceed according to inductive logic, the hypothetico-deductive approach, or perhaps according to a falsification criterion. The result of successful testing is at best confirmation or corroboration, which is not truth but rather measured consistency with empirical evidence. Inadequate model confirmation increases the risks associated with the application of the model. Model confirmation costs must be compared with the risk resulting from the use of an unconfirmed model. If confirmation is to be meaningful, rigorous statistical tests must be applied, and calibration-independent data are needed. A number of plausible candidate models (or model sub-routines) should undergo confirmation. Comparison of the performance of the candidates aids the modeler in the determination of the degree of confirmation. (Moore-IVI)
W84-02538

PRODUCTION AND POPULATION DYNAMICS OF CAPITELLA CAPITATA,
Southampton Univ. (England). Dept. of Oceanography.
J. A. Oyenekan.
Archiv fur Hydrobiologie, Vol. 98, No. 1, p 115-126, September, 1983. 7 Fig, 2 Tab, 23 Ref.

Descriptors: *Polychaetes, *Bioindicators, *Capitella, *Population dynamics, *England, Copper, Silt, Hydrocarbons, Reproduction, Larvae, Water pollution effects, Estuarine environment.

A study was made on the production and population dynamics of Capitella capitata occurring in the Southwestern region of Southampton Water, South England. C. capitata was the most abundant polychaete in sediments containing high levels of copper and hydrocarbon. Its abundance was related to silt, copper and hydrocarbon contents of the sediment at two sites near Fawley Esso Petroleum Refinery. Greater densities of C. capitata occurred near the refinery outfalls which contained high levels of sediment copper and hydrocarbon. The C. capitata population in Southhampton Water shows a complex, unsynchronized life cycle with a polytelic pattern of reproduction. Gametes are released throughout the year with peaks in June and December. Benthic larvae resulted from large summer eggs brooded in the parent's tubes but winter larvae failed to settle until spring. Annual production was estimated as 1.6198 and 0.382 g/sq m/yr respectively at the two sites and P:B ratio varied between 3.26 and 11.6. (Moore-IVI)
W84-02552

DETERMINATION OF TOTAL CYANIDE IN THIOCYANATE-CONTAINING WASTEWATERS,
Baker (J.T.) Chemical Co., Phillipsburg, NJ.
N. J. Csikai, and A. J. Barnard, Jr.
Analytical Chemistry, Vol. 55, No. 11, p 1677-1682, September, 1983. 2 Fig, 5 Tab, 27 Ref.

Descriptors: *Cyanide, *Wastewater analysis, *Thiocyanates, Metal cyanides, Nitrates, Oxidants, Interference.

The determination of total cyanide is an important test in assessing wastewaters. The term total cyanide implies the sum of free cyanide present in a sample and produced in a sample treatment that disrupts complex metal cyanides. At high acidities, thiocyanate reacts with nitrate or other oxidants to produce free cyanide. For thiocyanate-containing wastewaters, a total cyanide procedure is reported based on use of EDTA at pH 4.0, acetate buffered, to disrupt the complexes of cadmium, chromium, copper, iron, nickel, and zinc. Nitrite interference is obviated by adding sulfamic acid to the sample. Sulfides are removed from the sample by initial treatment with cadmium carbonate and, if necessary, from distillates with cadmium nitrate. Cyanide can then be determined by either photometry or potentiometry. In evaluating the procedure, both free cyanide and complex metal cyanides were added to both deionized water solutions and wastewater samples containing or spiked with nitrate and thiocyanate. The recovery of cyanide was virtually complete. (Moore-IVI)
W84-02556

DETERMINATION OF ANILINE AND SUBSTITUTED DERIVATIVES IN WASTEWATER BY GAS AND LIQUID CHROMATOGRAPHY,
Battelle Columbus Div., OH.
R. M. Riggin, T. F. Cole, and S. Billets.
Analytical Chemistry, Vol. 55, No. 12, p 1862-1869, 1983. 4 Fig, 5 Tab, 15 Ref. EPA contract 68-03-2952.

Descriptors: *Anilines, *Wastewater analysis, *Gas chromatography, *Liquid chromatography, Industrial wastewater, Effluents.

Gas chromatography (GC) and high performance liquid chromatography (HPLC) methods were evaluated for the determination of anilines in aqueous media. An optimized analytical approach based on GC with thermionic nitrogen-phosphorus selective detection (NPD) is capable of determining a wide variety of anilines at the low part-per-billion level in industrial aqueous discharges, as well as effluents from publicity owned treatment works (POTW). This approach offers better selectivity and sensitivity than HPLC and other GC detectors. A conventional solvent extraction scheme using methylene chloride gave adequate recovery from aqueous waste samples, but cleanup required substantial attention to avoid adsorptive losses. Capillary column chromatography with an SE-54 FSCC offers better sensitivity and selectivity than the optimum packed column. Analytical precision was generally 5-15% RSD and recoveries were generally 75% or better. (Moore-IVI)
W84-02557

MODIFICATION OF THE DETERMINATION OF ORGANIC COMPOUNDS BY HEADSPACE GAS CHROMATOGRAPHY AFTER SORPTION ON SOLID SORBENTS AND LIQUID DESORPTION,
Gdansk Technical Univ. (Poland). Inst. of Inorganic Chemistry and Technology.
A. Przyjazny, W. Janicki, W. Chrzanowski, and R. Staszewski.
Journal of Chromatography, Vol. 262, p 199-209, June, 1983. 3 Fig, 2 Tab, 11 Ref. Polish Academy of Sciences grant MR.I-15.

Descriptors: *Organic compounds, *Gas chromatography, Water analysis, Pollutant identification, Sorption, Desorption, Dimethyl sulfoxide.

The determination of organic pollutants in water and the atmosphere by gas chromatography frequently requires a preconcentration step, usually sorption on solid sorbents, due to their low concentration. A method of determination of organic compounds by headspace gas chromatography after sorption on solid sorbents and liquid desorption has been developed. Water (50%) is added to dimethyl sulfoxide after completion of desorption, which results in an increase of up to two orders of magnitude in the concentration of compounds in the gaseous phase. Owing to its increased sensitivity, the method can be employed for the determination of compounds in the sub-ppb range from small volumes of air or water. An apparatus enables simultaneous analysis of several samples containing compounds with high and low boiling points without the loss of the latter, and multiple extraction of

the sorbent bed. Average recoveries of model compounds are close to 100%, indicating the high accuracy of the method. The calibration curves were linear over the studied range of concentrations. The overall precision, expressed as the relative pooled standard deviation, varied from 2.4% for (CH3)2S to 5.2% for (C2H5)2S2 for samples and from 2.5% for (CH3)2S to 9.1% for (C2H5)2S2 for standards. The detection limit was estimated to be 0.17, 0.77 and 0.76 ppb for (CH3)2S, (CH3)2S2 and (C2H5)2S2, respectively, assuming a 1-cu dm liquid sample. (Moore-IVI)
W84-02559

PHOSPHORUS FLUX RATES IN LAKE SEDIMENTS,
Washington State Water Research Center, Pullman.
S. J. Mawson, H. L. Gibbons, Jr., W. H. Funk, and K. E. Hartz.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1105-1110, August, 1983. 3 Fig, 3 Tab, 23 Ref. EPA contract R805604-01.

Descriptors: *Phosphorus, *Lake sediments, Liberty Lake, Washington, Sediments, Dissolved oxygen, Sediment-water interfaces, Interfaces, Mud-water interfaces.

The release of phosphorus from Liberty Lake sediments was quantified as a function of dissolved oxygen concentrations at the sediment water interface. Liberty Lake sediments range from sand overlying clay at the northwest end to consolidated fibrous plant detrital materials at the south end. A significant release of phosphorus was noted, ranging from a maximum for total phosphorus in the refractory organic silt (ROS) sediments of 127 micrograms/sq m/hr under anaerobic conditions to a minimum of .000979 micrograms/sq m/hr for soluble reactive phosphate (SRP) under aerobic conditions. Maximum release rate observed for heavy organic muck (HOM) sediments was 54.2 micrograms/sq m/hr for total phosphorus under anaerobic conditions. The impact of the release on the phosphorus loading of the lake is a function of the dissolved oxygen concentration at the sediment water interface. The release of soluble reactive phosphate (SRP) is greatest from the HOM sediment, probably due to the greater interstitial phosphate concentrations present in these sediments. (Baker-IVI)
W84-02578

COMPREHENSIVE PROGRAM FOR SURVEILLANCE OF PACKAGE PLANTS AND STABILIZATION PONDS,
Mid-Ohio Valley Health Dept., Parkersburg, WV.
For primary bibliographic entry see Field 5D.
W84-02582

A MARINE RECREATIONAL WATER QUALITY CRITERION CONSISTENT WITH INDICATOR CONCEPTS AND RISK ANALYSIS,
V. J. Cabelli, A. P. Dufour, L. J. McCabe, and M. A. Levin.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1306-1314, October, 1983. 3 Fig, 4 Tab, 37 Ref.

Descriptors: *Recreation, *Indicator organisms, *Water quality, Risk analysis, Risks, Human diseases, Public health, Fecal coliforms, Coliforms, Microorganisms, Enterococcus, Swimming, Marine environment.

The derivation of guidelines and standards based on acceptable risk for recreational water quality is explained. The two microbial guidelines or standards most commonly used in the U.S. are the total coliform limit of 1000/100 mL of water and the fecal coliform limit of 200/100 mL. The microbial guideline states that fecal coliforms should be used as the indicator organism for evaluating the microbiological suitability of recreational waters. Coliforms were rejected as the indicator of choice for evaluating sanitary conditions because of their variable correlation with fecal contamination. Ideally, recreational water quality indicators are microorganisms or chemicals whose densities or concentrations in the water can be quantitatively related to swimming-associated health hazards. One problem with the existing microbial guidelines for direct contact recreational waters is that they are not amenable to, or developed in the context of, risk analysis. They were derived from a barely detectable health effect rather than from exposure-response data. Therefore they do not allow for deliberate decisions by local, state, or federal officials about incremental decreases in the health risks involved. Rather, decision making is limited to acceptance or rejection of the specific limits. In a three year study of New York City beaches performed to determine which were the best indicators, the superiority of enterococci versus fecal coliforms was seen from the regression lines displayed on graphs of linear relationships between swimming-associated rates for gastrointestinal symptoms and mean enterococcus and fecal coliform densities in the water. Not only is this criterion more reliable because of the greater credibility of the information obtained, but also the consequences of the illness are more amenable to economic analysis. (Baker-IVI)
W84-02600

ONE-YEAR SURVEY OF ATP AND DYNAMIC BEHAVIOR OF AN ACTIVATED SLUDGE TREATMENT PLANT,
Laval Univ., Quebec. Dept. de Genie Chimique.
D. Roy, A. LeDuy, and P. H. Roy.
Journal of the Water Pollution Control Federation, Vol. 55, No. 11, p 1348-1354, November, 1983. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Activated sludge process, *Adenosine triphosphate, Wastewater treatment, Monitoring, Sludge, Aeration, Suspended solids, Bacteria, Fungus, Aerated lagoons.

Results are reported from a 1-year survey on the adenosine triphosphate (ATP) and dynamic behavior of a full-scale domestic wastewater treatment plant. The data is analyzed to investigate any relationships between ATP or ATP pool and other biomass related variables, operating conditions or BOD reduction. The reproducibility of the survey data was excellent for ATP and mixed liquor volatile suspended solids (MLVSS) concentrations in two aerated basins, operated in parallel. Under transient conditions, a linear relationship was found between mixed liquor suspended solids (MLSS) and MLVSS. Under the same dynamic conditions the measurement of ATP did not estimate MLVSS or other biomass-related variables such as the MLSS and the bacterial count. The excellent correlations under dynamic conditions most frequently observed were between MLVSS and fungal count. The ATP could be a good indicator of perturbations of the viability of the microbial flora in the aerated basins. Concentration and viability of the microbial flora were very sensitive to the recycle-flow rate and the sludge wasting rate. The dynamic behavior of the ATP pool in response to the recycling and wasting disturbances confirmed other conclusions for laboratory-scale activated sludge units. No direct relationship was found between BOD5 removal and bacterial or fungal count. However, poor performance of the aerated basins was observed when microbial counts or ATP concentrations were low. (Baker-IVI)
W84-02601

CHEMICAL COMPOSITION AND POSSIBLE MUTAGENICITY OF MUNICIPAL SLUDGES,
Missouri Univ.-Columbia. Environmental Trace Substances Research Center.
T. E. Clevenger, D. D. Hemphill, K. Roberts, and W. A. Mullins.
Journal of the Water Pollution Control Federation, Vol. 55, No. 12, p 1470-1475, December, 1983. 5 Fig, 7 Tab, 12 Ref.

Descriptors: *Sludges, *Chemical analysis, *Land disposal, Municipal wastes, Metals, Organic compounds, Pesticides, Herbicides, PCB, Boron, Beryllium, Cadmium, Chromium, Copper, Manganese, Magnesium, Nickel, Lead, Zinc, Mercury, Arsenic, Selenium, Iron, Potassium, Sodium, Nitrogen, Phosphorus.

Of 74 wastewater treatment facilities studied, none had sludges with significant levels of the tested toxic organic compounds: PCB, lindane, chlorodane, aldrin, hept epox, DDE, dieldrin, endrin, DDT, or BHC. All sludges had high levels of nutrients and could be a source of excellent fertilizer. Some sludges did have high levels of potentially toxic heavy metals, when tested for calcium, iron, potassium, magnesium, sodium, phosphorus, nitrogen, boron, beryllium, cadmium, chromium, copper, manganese, nickel, lead, zinc, mercury, arsenic, and selenium. The application rate of these sludges will be severely limited due to the presence of these metals, if indeed they can be used at all. The mutagenicity potential of sludges from five facilities was evaluated with the Ames test. The results of these tests were negative indicating no mutagenicity. With but a few exceptions, the sludges from the 74 cities in this study should be acceptable for agricultural land applications if the guidelines established by the State of Missouri are followed. (Baker-IVI)
W84-02606

HEXAVALENT CHROMIUM-RESISTANT BACTERIA ISOLATED FROM RIVER SEDIMENTS,
Ohio State Univ., Columbus. Dept. of Microbiology.
G. W. Luli, J. W. Talnagi, W. R. Strohl, and R. M. Pfister.
Applied and Environmental Microbiology, Vol. 46, No. 4, p 846-854, October, 1983. 6 Tab, 35 Ref.

Descriptors: *Chromium, *Bacteria analysis, *Sediments, *Water pollution effects, Cobalt, Antimony, Zinc, Ottawa River, Water analysis, Industrial wastes, Bacteria, Sediment contamination.

Hexavalent chromium, Cr(VI), is a known carcinogen and mutagen; however, the actual mechanisms of Cr toxicity are unknown. Two approaches were used to isolate Cr(VI)-resistant bacteria from metal-contaminated river sediments. Diluted sediments were plated directly onto a peptone-yeast extract (PYE) medium containing 0 to 100 micro g of Cr(VI)/ml. Approximately 840,000 CFU/g were recovered on 0 micro g of Cr(VI)/ml, whereas 400 CFU/g were recovered on PYE plus 100 micro g of Cr(VI)/ml. Alternatively, continuous culture enrichment techniques were employed using PYE and 100 micro g Cr(VI)/ml input at dilution rates of 0.02 and 0.10/h. After six residence periods, 1,000,000,000 CFU were recovered on PYE agar containing 0 micro g of Cr(VI)/ml and 10,000,000 CFU on PYE agar plus 100 micro g of Cr(VI)/ml. Of 89 isolates obtained by direct plating onto PYE, 47% were resistant to 100 micro g of Cr(VI)/ml, and 20% were resistant to 250 micro g of Cr(VI)/ml. When the same isolates were plated onto PYE containing Cr(III), 88% were resistant to 100 micro g/ml but only 2% were resistant to 250 micro g/ml. Cr, Co, Sb, and Zn were found in significantly higher concentrations at an industry-related contaminated site than at a site 11 km downstream. Total Cr in the sediments at the contaminated site averaged 586 micro g (dry weight)/g, and the downstream site averaged 71 micro g (dry weight)/g. The Cr recovered from acid-digested Ottawa River sediment samples was predominantly hexavalent. Five acid digestion procedures followed by atomic absorption spectroscopy were compared and found to be 30 to 70% efficient for recovery of Cr relative to neutron activation analysis. A population of aerobic, heterotrophic bacteria was recovered from sediments containing elevated levels of Cr. However, there was no apparent difference in the number of bacteria resistant to Cr(VI) at the contaminated site as compared to the downstream site. Recovery of Cr-resistant bacteria from river sediments was improved by using continuous culture enrichment as compared to direct plating. (Author's abstract)
W84-02611

MODIFICATION OF DELAYED-INCUBATION PROCEDURE FOR DETECTION OF FECAL COLIFORMS IN WATER,

New York State Office of Public Health, Albany. Center for Labs. and Research.
M. Chen, and P. J. Hickey.
Applied and Environmental Microbiology, Vol. 46, No. 4, p 889-893, October, 1983. 6 Tab, 11 Ref.

Descriptors: *Coliforms, *Bacterial analysis, *Membrane filters, *Holding media, Fecal coliforms, Delayed incubation, Natural waters, Sublethal injury.

Holding media, including the vitamin-free Casitone holding medium (m-VFC) recommended by Standard Methods for the Examination of Water and Wastewater (American Public Health Association, Inc., Washington, D.C., 1980) for use with the delayed-incubation membrane filter procedure, were compared for their ability to maintain viability of fecal coliforms. Delayed-incubation test methods require the use of a holding medium to stabilize bacteria trapped on the surface of a membrane filter while the filter is transported to the laboratory. The media were tested with 60 to 80 pure cultures of fecal coliforms and a variety of natural water samples containing fecal coliforms. Fecal coliform recovery with m-ST holding medium (containing ethanol, sulfanilamide, and Tris at pH 8.6) was significantly greater than recovery with m-VFC (containing vitamin-free casein hydrolysate, sodium benzoate, sulfanilamide, and ethanol). Recovery with m-VFC, was, in turn, significantly greater than with NSB medium (containing nutrient broth, boric acid, and NaCl as major ingredients). Fecal coliform counts obtained with m-ST by the delayed-incubation membrane filter procedure were higher than counts obtained by the standard immediate incubation. Some of the sublethally injured fecal coliforms in natural water samples may have recovered during the incubation period. m-ST is recommended for use in place of m-VFC for the delayed-incubation membrane filter procedure. An improved delayed-incubation membrane filter procedure will enable health authorities to make more reliable estimates of bacterial contamination in the natural aquatic environment and will aid in the identification of sources of contamination. Such a test may also permit bacteriological testing of recreational and other natural waters in areas where testing was previously not possible. (Moore-IVI)
W84-02612

EVALUATION OF FILTERS FOR RECOVERY OF CAMPYLOBACTER JEJUNI FROM WATER,
Texas Univ. Medical School at Houston.
J. J. Mathewson, B. H. Keswick, and H. L. DuPont.
Applied and Environmental Microbiology, Vol. 46, No. 5, p 985-987, November, 1983. 2 Tab, 7 Ref. PHS grant AI-07128.

Descriptors: *Campylobacter, *Microporous filters, *Bacterial analysis, *Depth filters, Public health, Water analysis.

Campylobacter jejuni has been incriminated in several large waterborne outbreaks, but it has rarely been isolated from water itself. Better methodology is needed for the isolation of C. jejuni from water. Three types of 0.45-micro m microporous filters and three different pore sizes of positively charged depth filters were evaluated for their ability to recover C. jejuni from seeded, sterile tap and surface water. The microporous filters tested were Millipore HA, Gelman GN6, and Zetapor. Three pore sizes of Zeta Plus depth filters (05S, 20S, and 50S) were evaluated by using an adsorption-elution technique. The overall percent recovery in both tap and surface water by microporous filters was: Zetapor, 66%; Millipore HA, 33%; and Gelman GN6, 33%. Adsorption-elution with Zeta Plus 50S allowed 89% recovery of C. jejuni. These data suggest that both the positively charged Zetapor microporous filter and the Zeta Plus 50S depth filter are effective filters for the recovery of C. jejuni from water. (Author's abstract)
W84-02613

MICROPLATE FECAL COLIFORM METHOD TO MONITOR STREAM WATER POLLUTION,
Centre des Sciences de l'Environment, Metz (France).
A. Maul, and J. C. Block.
Applied and Environmental Microbiology, Vol. 46, No. 5, p 1032-1037, November, 1983. 1 Fig, 4 Tab, 29 Ref.

Descriptors: *Coliforms, *Bacterial analysis, *Water pollution, Stream pollution, Moselle River, Fecal coliforms, Water analysis, Most probable number test.

A study has been carried out on the Moselle River by means of a microtechnique based on the most-probable-number method for fecal coliform enumeration. This microtechnique, in which each serial dilution of a sample is inoculated into all 96 wells of a microplate, was compared with the standard membrane filter method. It showed a marked overestimation of about 14% due, probably, to the lack of absolute specificity of the method. The high precision of the microtechnique (13%, in terms of the coefficient of variation for log most probable number) and its relative independence from the influence of bacterial density allowed the use of analysis of variance to investigate the effects of spatial and temporal bacterial heterogeneity on the estimation of coliforms. Variability among replicate samples, subsamples, handling, and analytical errors were considered as the major sources of variation in bacterial titration. Variances associated with individual components of the sampling procedure were isolated, and optimal replications of each step were determined. Temporal variation was shown to be more influential than the other three components (most probable number, subsample, sample to sample), which were approximately equal in effect. However, the incidence of sample-to-sample variability (16%, in terms of the coefficient of variation for log most probable number) caused by spatial heterogeneity of bacterial populations in the Moselle River is shown and emphasized. Consequently, it is recommended that replicate samples be taken on each occasion when conducting a sampling program for a stream pollution survey. (Author's abstract)
W84-02614

EFFECT OF AMBIENT TEMPERATURE STORAGE ON POTABLE WATER COLIFORM POPULATION ESTIMATIONS,
Wisconsin State Lab. of Hygiene, Madison.
J. H. Standridge, and J. J. Delfino.
Applied and Environmental Microbiology, Vol. 46, No. 5, p 1113-1117, November, 1983. 4 Tab, 8 Ref.

Descriptors: *Sample preservation, *Sample storage, *Potable water, *Coliforms, Bacterial analysis, Water analysis, Statistical methods, Wisconsin.

Reducing the length of time between sampling potable water and performing coliform analyses may substantially increase costs for water analysis programs. A protocol was developed which uses statistics and probability theory to develop conclusions for a large group of samples by examining data obtained from a smaller group of samples. The intent of this protocol is to provide a facile means of studying the effects of potable water sample storage without costly replicate testing of thousands of samples. Randomly selected samples (from those routinely collected throughout the State of Wisconsin) were analyzed for total coliforms after being held at room temperature (20 + or - 2 C) for 24 and 48 h. Differences in results for the two holding times were compared with differences predicted by probability calculations. Storage of the potable water for up to 48 h had little effect on the public health significance of most samples containing more than two coliforms per 100 ml. Public health officials can decide whether the advantages of allowing samples to be stored for up to 48 h outweigh the disadvantage of not detecting a very small percentage of samples containing 1 or 2 coliforms per 100 ml for the MF test or 2.2 coliforms per 100 ml for the MPN test. (Moore-IVI)
W84-02616

ORGANIC POLLUTANTS IN MARINE SAMPLES FROM PORTLAND, MAINE,
Texas A and M Univ., College Station. Dept. of Chemistry.
L. E. Ray, H. E. Murray, and C. S. Giam.
Chemosphere, Vol. 12, No. 7/8, p 1031-1038, 1983. 1 Fig, 3 Tab, 28 Ref. NSF grants OCE77-25663 and OCE78-02023.

Descriptors: *Portland, *Maine, *Marine sediments, *Organochlorine compounds, *Phthalates, *Marine pollution, Clams, Neanthes, Harbors, DDT, Polychlorinated biphenyls, Biological magnification, Fore River, Back Cove.

The concentrations of several organochlorine compounds and two phthalates, di(n-butyl) phthalate (DBP) and di(2-ethylhexyl) phthalate (DEHP), were measured in sediment, clams and Neanthes virens obtained from Back Cove and the Fore River, Portland Harbor, Maine. Numerous industrial plants located along the harbor are major potential sources of organic contaminants to the area. The area is also a major oil import center, which increases the problem of pollution. The concentrations in sediment ranked as follows: DEHP >> DBP > PCBs >> sigma DDT > chlordane > pentachorophenol (PCP) > alpha-hexachlorocyclohexane similar to hexachlorobenzene. Except for a reversal of PCP and chlordane, the same order was observed in biota. Adsorption of the pollutants onto sediment seemed to protect the biota since the bioconcentration factors for chlordane, DBP and DEHP were less than one; i.e., concentrations in tissue were lower than those in sediment. For the other five compounds there was a very low level of bioconcentration (1.0 to 150 fold). Although most industrial and petroleum-shipping activity is along the Fore River, the most polluted sediment samples were those obtained from Back Cove. This suggests that the flushing action provided by the Fore River and its tributaries is important, and relatively efficient, in washing the pollutants out before they are adsorbed onto the sediment. (Moore-IVI)
W84-02627

ANALYSIS OF WATER AND SEDIMENT FROM THE NUECES ESTUARY/CORPUS CHRISTI BAY (TEXAS) FOR SELECTED ORGANIC POLLUTANTS,
Texas A and M Univ., College Station. Dept. of Chemistry.
L. E. Ray, H. E. Murray, and C. S. Giam.
Chemosphere, Vol. 12, No. 7/8, p 1039-1045, 1983. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Estuarine environment, *Organic compounds, *Sediments, *Nueces Estuary, *Corpus Christi Bay, *Texas, *Chlorinated hydrocarbons, Hydrocarbons, pesticides, Phthalate esters, Pentachlorophenol, Polycyclic aromatic hydrocarbons, Water pollution sources.

The concentrations of various organic pollutants (PCBs, phthalate esters (PAEs), hexachlorobenzene (HCB), pentachlorophenol (PCP), polycyclic aromatic hydrocarbons (PAHs), and chlorinated hydrocarbon pesticides (CHPs)) were determined in samples of water and sediment from various sites in the Nueces Estuary, Texas. In sediment, the relative concentrations were sigma PAEs >> PCB > sigma CHPs > PCP > HCB; the relative concentrations in water were sigma PAEs > PCP > PCB > sigma CHPs > HCB. In water, the ranking of concentrations corresponds closely to the water solubilities of the compounds, although the measured values are well below the maximum solubilities of each compound. No single site was highest or lowest in regard to all the pollutants measured. However, the site at the city sewage outfall was the highest in three of the five pollutants in water and four of the five pollutants in sediment. A site near industry was the lowest in regard to three of the five pollutants in water, and the 'clean' site was lowest in regard to four of the five pollutants in sediment. (Moore-IVI)
W84-02628

SNAPPING TURTLES - A BIOLOGICAL SCREEN FOR PCB'S,

State Univ. of New York at Albany. Dept. of Chemistry.
P. G. Olafsson, A. M. Bryan, B. Bush, and W. Stone.
Chemosphere, Vol. 12, No. 11/12, p 1525-1532, 1983. 2 Fig, 2 Tab, 17 Ref.

Descriptors: *Pollutant identification, *Organic compounds, *Turtles, *Polychlorinated biphenyls, Organochlorine compounds, Aroclor, Hudson River, Lake Ontario, Great Lakes, Mirex, DDE.

Two snapping turtles, one male of 16.5 kg from Irondequoit Bay, Lake Ontario and a male 17.8 kg for the Upper Hudson River near Hudson Falls, were examined. These two localities had already been shown to contain organic pollutants. A high level of PCB contamination is known to exist in the upper Hudson River, whereas a lower concentration of PCB with the additional pollutant Mirex was associated with Lake Ontario. A total PCB concentration of 3608 ppm was noted in the fat of the turtle from the upper Hudson River. Mirex was found at the 28 ppm level in the Lake Ontario turtle. These findings indicate that snapping turtles are able to store high concentrations of PCB's in their fat without any apparent detrimental effect. The high biomagnification thus permissible allows a wide gradation between the extremes in pollution levels. Furthermore, it facilitates the detection of extremely toxic substances which may be present only in trace amounts. It may be that snapping turtles provide a valuable addition to the species used for monitoring water quality. (Baker-IVI)
W84-02635

THE FLAME RETARDANT TETRABROMOBISPHENOL-A AND ITS METABOLITE FOUND IN RIVER AND MARINE SEDIMENTS IN JAPAN,
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Chemosphere, Vol. 12, No. 11/12, p 1533-1539, 1983. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Tetrabromobisphenol-A, *Flame retardants, *Osaka, *Japan, River sediments, Marine sediments, Metabolism, Sediment contamination.

Tetrabromobisphenol-A (TBBP), used as a flame retardant for epoxy and polyester resins, was detected in river sediments collected in Osaka, Japan, at concentrations ranging from 22 to 140 micro g/kg (ppb), as determined on a dry weight basis. TBBP was also found in marine sediments collected at Osaka Bay, though the TBBP levels of these samples were much lower than those from river sediments. The dimethyl ether derivative of TBBP (TBBP-DM), thought to be a decomposition product from microbial methylation, was found in the river sediments but in none of the marine sediments. TBBP-DM residues were about one-hundredth of the TBBP levels. TBBP was not present in commercial TBBP products. It may be a decomposition product of microbial methylation in the sediments. The sediment pollution by TBBP in the Osaka area is widespread and quite serious, particularly in rivers. (Moore-IVI)
W84-02636

THE ANALYSIS OF ORGANOHALIDES IN WATER - AN EVALUATION UPDATE,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. C. Dressman, and A. A. Stevens.
Journal of the American Water Works Association, Vol. 75, No. 8, p 431-434, August, 1983. 5 Tab, 6 Ref.

Descriptors: *Water analysis, *Organohalides, Organic compounds, Halides, Halogens, Chlorine, Trihalomethanes, Water quality control.

Data acquired during the routine use of an organic halide analyzer are presented. These data were used for judging the quality of measurements of total, purgeable, and nonpurgeable organic halides as well as judging the instrument's dependability and ease of operation. The repeatability of results obtained during routine analysis was used to set criteria for accepting or rejecting data. Duplicates of samples containing a total organic halide (TOX) concentration of 25 micrograms Cl/liter or less were accepted if within 34% of one another. Duplicates of samples containing more than 25 micrograms of Cl/liter were accepted if within 16% of one another. The method for determining purgeable organic halides (POX) was compared with the purge and trap method for determining total trihalomethanes. A decrease or increase in TOX concentration of the sample during storage can adversely affect the quality of measurements. A two-week holding time was suggested to avoid problems with a decrease in TOX. Sodium sulfite crystals rather than highly unstable sodium sulfite in solution should be used for reducing residual chlorine. (Baker-IVI)
W84-02669

EFFECTS OF HOLDING TIME AND TEMPERATURE ON COLIFORM NUMBERS IN DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office.
A. E. McDaniels, and R. H. Bordner.
Research and Technology, Vol. 75, No. 9, p 458-463, September, 1983. 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Coliforms, *Drinking water, *Water analysis, Bacteria, Water quality control, Potable water, Sampling.

Samples collected from a municipal distribution system were split, stored at ambient temperature (22 degrees C), and refrigerator temperature (5 degrees C) and analyzed over time for total coliform and heterotrophic bacterial densities. Coliform populations declined significantly at both temperatures after 24 hours. The rate of decline was 2.5 orders of magnitude greater at 22 degrees C than at 5 degrees C. Average losses in 24 hours were 34% at 5 degrees C and 87% at 22 degrees C. Growth and interference of heterotrophic bacteria with coliform colonies on membrane filter plates were frequently observed for samples held at ambient temperature for 30 hours. A model based on actual coliform recovery was developed to predict initial coliform counts in samples held at various times before examination. For the waters examined, samples held at 22 degrees C for 30 hours with initial coliform counts as high as 100/100 mL could have been reported as satisfactory, thus resulting in inaccurate and misleading information. (Baker-IVI)
W84-02670

MICROBIAL ALTERATIONS IN WATER DISTRIBUTION SYSTEMS AND THEIR RELATIONSHIP TO PHYSICAL-CHEMICAL CHARACTERISTICS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
C. N. Haas, M. A. Meyer, and M. S. Paller.
Journal of the American Water Works Association, Vol. 75, No. 9, p 475-481, September, 1983. 8 Tab, 14 Ref.

Descriptors: *Microorganisms, *Water distribution, Water quality control, Population dynamics, Temperature effects, Acidity, Organic carbon, Organic compounds.

A statistical analysis was performed of microbial and physical chemical data to determine whether variations in microbial dynamics were related to variations in physicochemical variables in water distribution systems. Total organic carbon did not appear to be a significant parameter in controlling microbial populations in water distribution systems. Increasing values of pH, temperature, and turbidity were associated with increasing concentrations of microorganisms in water distribution systems. Although an inverse association exists between chlorine residuals and microbial densities, this association explains only a small proportion of the variance in microbial densities. Thus, this study does not support the hypothesis of a consistent association of major importance between residual chlorine and microbial water quality parameters in distribution systems. Total coliforms can be isolated from water distribution samples for which the physical and chemical water quality is indistinguishable from the water quality of samples that have no coliforms. The use of TOC, turbidity, pH, temperature, and chlorine residual measurements is insufficient to estimate, with a high degree of reliability, either the density or the changes in density of microorganisms in water distribution systems. Incorporation of a time of year variable does little to improve the associations developed. Thus, either additional physical and chemical parameters are important in governing microbial dynamics in water distribution systems or there is a significant random component. In either case, control of one or more of the physical chemical variables measured in this study is insufficient to assure consistent microbial concentrations. (Baker-IVI)
W84-02672

METHODS FOR TESTING THE EFFICACY OF ULTRAVIOLET LIGHT DISINFECTION DEVICES FOR DRINKING WATER,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5F.
W84-02673

EELGRASS (ZOSTERA MARINA L.) AS AN INDICATOR ORGANISM OF TRACE METALS IN THE LIMFJORD, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
H. Brix, J. E. Lyngby, and H. H. Schierup.
Marine Environmental Research, Vol. 8, No. 3, p 165-181, 1983. 6 Fig, 2 Tab, 46 Ref.

Descriptors: *Eelgrass, *Bioindicators, *Trace metals, *Limfjord, *Denmark, Aalborg, Struer, Lead, Copper, Cadmium, Zinc, Interstitial water, Urban areas.

The concentrations of Pb, Cu, Cd and Zn were determined in above- and belowground parts of eelgrass (Zostera marina L.) at forty stations in a shallow, brackish water area (the Limfjord, Denmark). The concentrations of the trace metals were significantly elevated near the cities of Aalborg (Pb, Cu) and Struer (Cd). Trace metals concentrations in above and belowground parts of eelgrass were log-normal distributed and the concentrations of Cd, Cu and Zn in aboveground parts were significantly higher than in belowground parts. Furthermore, a significant correlation between trace metal concentrations in above- and belowground parts was found. The background level of trace metal concentrations in eelgrass in the Limfjord was estimated. The application of eelgrass as a monitoring organism is discussed; it is suggested that the concentration of some trace metals in above- and belowground parts of eelgrass may be used as a measure of the bioavailable fraction of these trace metals in ambient and interstitial water (sediment), respectively. (Author's abstract)
W84-02693

CONCENTRATIONS OF UNSUBSTITUTED POLYNUCLEAR AROMATIC HYDROCARBONS IN BAY MUSSELS (MYTILUS EDULIS) FROM OREGON, USA,
Oregon State Univ., Corvallis. Dept. of General Science.
M. C. Mix, and R. L. Schaffer.
Marine Environmental Research, Vol. 9, No. 4, p 193-209, 1983. 1 Fig, 4 Tab, 30 Ref.

Descriptors: *Mussels, *Hydrocarbons, *Aromatic compounds, *Yaquina Bay, *Oregon, *Polynuclear aromatic hydrocarbons, Carcinogens, Pollutant identification, Liquid chromatography.

Concentrations of fifteen unsubstituted polynuclear aromatic hydrocarbons (PNAH) were measured in Mytilus edulis from two sites in Yaquina Bay, Oregon, during 1979-1980. M. edulis were collected monthly or bimonthly from two separate populations. Mussels from Y1M, an old railroad trestle, supported by weathered pilings, were sampled from January 1979 to June 1980, at which time the site was destroyed during the construction of a marina. The second population, from Y2M, where mussels were removed from wooden pilings and

metal ladders along the Oldtown bayfront, was smaller and sampling was discontinued after April 1980, due to the small number of mussels. The analytical procedure involved the use of high performance liquid chromatography to identify and quantify 15 unsubstituted PNAH including phenanthrene, fluoranthene, pyrene, benzo(c)phenanthrene, triphenylene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,c)anthracene, benzo(a)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene and coronene. There were significant differences in PNAH levels between the two populations. The average total concentrations in mussels inhabiting the more industrialized Y2M was 986.2 micro g/kg compared with 273.9 micro g/kg in mussels from the more remote site Y1M across the bay. Substantial differences were found in the concentrations of different PNAH in M. edulis examined during this study. The smaller, more water soluble, compounds were concentrated to one or two orders of magnitude above the larger, less soluble PNAH. Thus, the more toxic 3- and 4-ring PNAH were present in much greater concentrations than the carcinogenic 5- and 6-ring PNAH. (Moore-IVI)
W84-02695

THE USE OF INTERFERENCE SUPPRESSANTS IN THE DIRECT FLAME ATOMIC ABSORPTION DETERMINATION OF METALS IN WATER; SOME PRACTICAL CONSIDERATIONS,
National Inst. for Water Research, Pretoria (South Africa).
R. Smith, E. M. Bezuidenhout, and A. M. van Heerden.
Water Research, Vol. 17, No. 11, p 1483-1489, 1983. 13 Fig, 4 Tab, 5 Ref.

Descriptors: *Interference, *Flame atomic absorption, *Trace metals, Ionization, Cesium, Lanthanum, Chromium, Calcium, Aluminum, Silica, Sulfates, Phosphates, Water analysis.

Standard water analysis methods recommend a variety of different interference suppressants to control chemical and ionization interference effects in the flame atomic absorption determination of certain metals in water. In order to overcome any confusion arising from the difference with regard to the use of interference suppressants, the adoption of a cesium/lanthanum 'universal' suppressant is suggested. In the studies of both the 12.5 g/l lanthanum and the 0.5 g/l cesium : 2 g/l lanthanum solutions proved to be satisfactory suppressants for the determination of calcium in the 10 waters analyzed, as well as for the suppression of up to 200 mg/l phosphate, sulfate and aluminum, and of up to about 25 m/l silica in the determination of 20 mg/l calcium in the synthetic samples. This suppressant is generally equal to or better than the other suppressants for the control of chemical and ionization interferences, and at considerable savings in time, reagents and glassware. (Murphy-IVI)
W84-02698

AN IMPROVED MICRODESULPHONATION/GAS LIQUID CHROMATOGRAPHY PROCEDURE FOR THE DETERMINATION OF LINEAR ALKYLBENZENE SULPHONATES IN U.K. RIVERS,
Unilever Research Port Sunlight Lab. (England).
J. Water, and J. T. Garrigan.
Water Research, Vol. 17, No. 11, p 1549-1562, 1983. 7 Fig, 5 Tab, 19 Ref.

Descriptors: *Water analysis, *Anionic surfactants, *Gas liquid chromatography, *Linear alkylbenzene sulfonates, United Kingdom, River Rhine, Pollutant identification, Methylene blue, Biodegradation.

An improved microdesulfonation/gas liquid chromatography (GLC) procedure is described for the specific determination of microgram/liter levels of linear alkylbenzene sulfonates (LAS) in aqueous environmental samples including sewage, sewage effluent and surface waters. The LAS is concentrated from samples as its methylene blue complex by a large-scale solvent extraction and is then freed from potential interferences by a series of clean-up steps, i.e. ion-exchange chromatography, hydrolysis and solvent extraction, prior to its desulfonation with a concentrated phosphoric acid reagent. The resulting alkylbenzene hydrocarbons are recovered and quantitatively determined by a capillary GLC technique with the aid of internal standards (primary and secondary alkylbenzene sulfonate isomers) added at the initial concentration stage. The introduction of the clean-up stages, particularly a selective extraction of the LAS as the 1-menthylheptyl amine salt into hexane, has resulted in GLC traces that are free from major interferences and in which it is possible to readily identify LAS isomers on the basis of the relative retention times. The procedure has a limit of detection of less than 10 micrograms/l LAS in a sample and allows the quantification of sub-microgram/liter levels of individual isomers (C9-C15 homologues). The mean recovery of a C12 LAS internal standard through the complete procedure is 91% for the environmental samples analysed. This procedure, together with a non-specific methylene blue colorimetric method (for determining anion surface active material), has been used in a monitoring exercise to establish the levels of LAS and methylene blue active substances (MBAS) in U.K. rivers and the River Rhine. A mean MBAS level of 0.15 mg/l was found at the U.K. river sites selected (35 samples), of which only 26% on average was attributable to LAS by microdesulfonation/GLC analysis. However, the levels of LAS and its contribution to the total MBAS in rivers was found to vary with the nature of the sampling location, i.e. depending whether it was above, below or in the vicinity of a sewage effluent discharge. The distribution of the LAS isomers at these sites also showed differences that could be explained in terms of their relative biodegradabilities. (Author's abstract)
W84-02703

MUTAGENICITY AND ORGANIC SOLUTE RECOVERY FROM WATER WITH A HIGH-VOLUME RESIN CONCENTRATOR,
Los Angeles County Sanitation Districts, Whittier, CA.
R. L. Jenkins, C. A. Jacks, R. B. Baird, B. J. Scheybeler, and L. B. Neisess.
Water Research, Vol. 17, No. 11, p 1569-1574, 1983. 2 Fig, 4 Tab, 20 Ref.

Descriptors: *Concentrators, *Mutagens, *Organic compounds, Potable water, Recovery, Resin columns, Wastewater, Water analysis, Wastewater analysis.

This concentrator utilizes low pressure filtration of a water sample followed by high pressure pumping through 45-75 micrometer macroporous ion exchange and nonionic resin columns. Elution and workup yields a concentrate in acetonitrile suitable for chemical analysis and bioassay. The high-volume sampler achieves an average 70% organic removal with four 1150 ml columns, from a 100-200 l wastewater or potable water sample pumped at 200 ml/min and 8000-10,000 kN/sq m. Sample elution yields composite resin concentrates which are mutagenic to Salmonella typhimurium strains TA98 and TA100. No mutagenicity is observed in concentrator effluents or in blanks between samples. The main advantage of the resin concentrator is in savings of time and solvent for a large sample volume. Recoveries of spikes of compounds taken from the EPA priority pollutant list are reported. (Murphy-IVI)
W84-02704

PENTACHLOROPHENOL BIODEGRADATION-I; AEROBIC,
Purdue Univ., Lafayette, IN. Environmental Engineering Lab.
L. P. Moos, E. J. Kirsch, R. F. Wukasch, and C. P. L. Grady, Jr.
Water Research, Vol. 17, No. 11, p 1575-1584, 1983. 9 Fig, 1 Tab, 26 Ref.

Descriptors: *Biodegradation, *Pentachlorophenol, Acclimation, Continuous Stirred Tank reactors, Volatilization, Wastewater, Sorption, Aerobic digestion, Suspended solids.

The biodegradation of pentachlorophenol (PCP) was tested in a three phase protocol. Phase I involved acclimation; phase II allowed determination of biodegradation kinetics through use of continuous stirred tank reactors (CSTR) operated at solids retention times of 3.2, 7.8, 12.8 and 18.3 days; phase III assessed the importance of volatilization and sorption in PCP removal and evaluated the extent of biodegradation. Over the range of stirred tank reactors studied, PCP was found to be biodegradable with first order kinetics; the rate constant had a value of 0.0017 L/micro g/d. The minimum concentration of PCP attainable in a CSTR was found to be 27 micrograms/L. Additional studies suggested that the full relationship between the PCP degradation rate and the PCP concentration followed an inhibition-type function, with the maximum rate occurring at a PCP concentration of around 350 micrograms/L. PCP was mineralized by the culture, with the liberation of CO2 and the incorporation of carbon into cell material. Neither volatilization nor sorption removed significant amounts of PCP from the reactors. (Author's abstract)
W84-02705

STRIPPING ANALYSIS OF ZINC IN NATURAL WATERS UTILIZING THE MEDIUM EXCHANGE METHOD,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
J. Wang, and B. Greene.
Water Research, Vol. 17, No. 11, p 1635-1638, 1983. 4 Fig, 9 Ref.

Descriptors: *Zinc, *Water analysis, *Medium exchange, *Anodic stripping voltammetry, Natural waters, Trace metals, Monitoring.

A simple and sensitive flow system for anodic stripping voltammetry (ASV) with medium exchange, utilizing the thin mercury film electrode and the differential pulse stripping mode is employed for monitoring trace metals in river water. Solution exchange is achieved by simply turning a three-way stopcock placed between the solution reservoirs and the detector. In order to minimize the interference due to the hydrogen evolution current, that masks the zinc peak in analysis of acidified natural waters, more suitable electrolyte is transferred (following the deposition step) into the detector. Measurements can be performed in the presence of oxygen in the sample solution, utilizing an oxygen free exchange solution. The method is sensitive, convenient, and easily adapted for continuous surveillance. (Moore-IVI)
W84-02710

SIMULTANEOUS DETERMINATION OF TOTAL NITROGEN AND TOTAL PHOSPHORUS IN WATER USING PEROXODISULFATE OXIDATION,
Kyoto Prefectural Inst. of Hygienic and Environmental Sciences (Japan).
J. Ebina, T. Tsutsui, and T. Shirai.
Water Research, Vol. 17, No. 12, p 1721-1726, 1983. 8 Fig, 6 Tab, 8 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Water analysis, Nitrates, Orthophosphates, Chemical analysis.

A method by which the total nitrogen (TN) and total phosphorus (TP) in water samples can be determined simultaneously employing peroxodisulfate oxidation was developed. A solution of 0.074 mol/l K2S2O8-0.075 mol/l NaOH was adopted for the oxidizer, which made it possible to carry out alkaline peroxodisulfate oxidation for TN and acid peroxodisulfate oxidation for TP in turn during a single autoclaving. The pH values changed from 12.57 to approximately 2.0 and the period of alkalinity was estimated at 1.42 min at 120 C. The products of oxidation were nitrates and orthophosphates and both were measured simultaneously by an AutoAnalyzer. In order to simplify the procedure as much as possible, test tubes almost as large as the sample cups placed on an AutoAnalyzer sampler were used as the digestion vessels and the contents in them were neutralized in the flow

system. Recoveries were excellent, with higher rates for nitrogen compounds than for the alkaline peroxodisulfate oxidation method. The limits of detection were satisfactory. The method has proven to be both simple and reliable and has made it possible to determine simultaneously and rapidly the TN and TP of large numbers of samples. (Moore-IVI)
W84-02717

ALL-WEATHER TROUGHS FOR PERIPHYTON STUDIES,
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
M. L. Bothwell.
Water Research, Vol. 17, No. 12, p 1735-1741, 1983. 6 Fig, 27 Ref.

Descriptors: *Periphyton, *Algae, *Troughs, Water pollution effects, Nutrients, Col weather apparatus, Biomass, Growth, Thompson River, British Columbia.

An on-site, experimental, continuous-flow trough system has been designed for intersite comparisons of periphyton settlement and net growth. The trough apparatus was used successfully in multiple experiments to compare the settlement and net growth of algal periphyton communities in different reaches of the Thompson River, British Columbia, upstream and downstream of point-source discharges of phosphorus. The study required experimental troughs with two unique capabilities; operation under ambient sub-zero temperatures, and determination of passive settlement rates at each site. The apparatus incorporates features that enable trouble-free operation in sub-zero weather. A dark-trough is used to measure passive settlement rates at each site. These values are used to correct light-trough accrual to obtain true net accumulation rates. Such corrections are needed for intersite comparison of periphyton growth rates by the biomass accrual method under conditions of slow algal growth. The low sampling variance, high analytical sensitivity and rapid chlorophyll accumulation characteristics of the troughs, combined with the use of a dark control have permitted the successful measurement and comparison of passive settlement rates of algal periphyton in different reaches of the Thompson River system. (Moore-IVI)
W84-02718

A COMPARISON OF MICROBIAL BIOASSAYS FOR THE DETECTION OF AQUATIC TOXICANTS,
Montana State Univ., Bozeman. Dept. of Microbiology.
G. A. McFeters, P. J. Bond, S. B. Olson, and Y. T. Tchan.
Water Research, Vol. 17, No. 12, p 1757-1762, 1983. 3 Fig, 1 Tab, 25 Ref. EPA grant R80725601.

Descriptors: *Bioassay, *Toxicity, *Bacteria, *Algae, Water pollution, Microorganisms, Fish, Herbicides, Luminescence.

The toxicity of 35 test chemicals was analyzed using two microbial bioassay systems. The commercially available Microtox Toxicity Analyzer System TM and the two-organism procedure of Tchan were used to determine the concentration of test chemicals resulting in a 50% reduction in response (EC50). Both of the tests employed a luminescent bacterium (Photobacterium phosphorium) while the procedure of Tchan also utilized an alga (Dunaliella tertiolecta). Results from the two microbial tests were compared with available data obtained with fish toxicity bioassays and with each other. The Microtox TM procedure was somewhat more sensitive than the Tchan bioassay in detecting most of the test chemicals and fish bioassays were generally more sensitive than either of the microbial tests. As a notable exception, photosynthesis-inhibiting herbicides were detected at remarkably lower concentrations with the procedure of Tchan than any of the other bioassays. The role of microbial bioassays is presently unclear. The greater sensitivity of traditional fish toxicity tests for many compounds must be weighed against the cost and time effectiveness of microbial methods. Greater sensitivity with the microbial tests might be achieved if toxic substances in water are suitable concentrated. (Moore-IVI)
W84-02720

SOME ELEMENTS COMPRISING PARTICULATE MATTER DURING SUMMER IN WATERS OF VARIOUS ENVIRONMENTS IN BRITISH COLUMBIA, CANADA,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
S. Ishizaka, J. G. Stockner, K. Kobayashi, K. Shima, and K. Katori.
Water Research, Vol. 17, No. 12, p 1815-1821, 1983. 4 Fig, 5 Tab, 25 Ref.

Descriptors: *British Columbia, *Particulate matter, *Trace elements, *Metals, Silicon, Iron, Chlorine, Calcium, Manganese, Zinc, Silicates, Glacial flower, Lakes, Marine environment, X-ray fluorimetry.

Multi-elemental traces comprising particulate matter in natural water collected during summer in 1978 and 1979 from British Columbia, Canada, were analyzed by alpha-particle excited X-ray fluorometry. Common elements from all waters examined were Si, Cl, Ca and Fe. The similarity of their distribution in different aquatic environments was statistically analyzed. They were distributed homogeneously in the marine environment but heterogeneously in the freshwater environments. No heavy metals concerned with the environmental standards were detected for all waters examined. Iron was found as the only common metal in the particulate matter, and the concentrations of iron were generally low. In glacially oligotrophic lakes, the concentration of Fe was highest and in a stagnant deep oligotrophic lake it was the lowest. Mn and Zn were the next most common metals. High concentrations of particulate silica reflect the presence of diatoms or silicoflagellates in oligo or mesotrophic waters and glacial flower containing silicate minerals in glacial lakes. Correlations suggest some inhibitory effects of Si and possibly Fe on the turnover rates of organic matter, i.e. inhibitory effects on the microbial activities responsible for the turnover. Iron increased the turnover rates in the marine environment. (Moore-IVI)
W84-02725

MICRODETERMINATION OF BROMIDE IN WATER BY GAS CHROMATOGRAPHY,
National Inst. of Hygienic Sciences, Tokyo (Japan).
M. Ando, and Y. Sayato.
Water Research, Vol. 17, No. 12, p 1823-1827, 1983. 8 Fig, 3 Tab, 17 Ref.

Descriptors: *Bromide, *Gas chromatography, *Ion-exchange chromatography, Water analysis, Chemical analysis, Interference.

Bromide of ppb levels in water can be accurately determined by ion-exchange chromatograph, potassium permanganate oxidation and head space gas chromatograph (ECD). Bromide reacted with citric acid and potassium permanganate to form pentabromoacetone, which then turned into bromoform. The bromoform was measured by a head space gas chromatograph. The formation of bromoform was interfered with by chloride, humic acid and phenol. The ion-exchange chromatograph (Amberlite CG-400, 10 mm i.d. X 70 mm; elutant 0.1 M sodium nitrate, 70 ml and 0.5 M sodium nitrate, 25 ml) was used to separate bromide from the interfering substances. The minimum detectable limit of bromide is 1 microgram (10 ppb) and the calibration curves maintain a linearity up to 150 micrograms (1.5 ppm). (Moore-IVI)
W84-02726

EXPERIMENTS USING DAPHNIA TO MEASURE LANDFILL LEACHATE TOXICITY,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
J. W. Atwater, S. Jasper, D. S. Mavinic, and F. A. Koch.
Water Research, Vol. 17, No. 12, p 1855-1861, 1983. 5 Fig, 5 Tab, 12 Ref.

Descriptors: *Landfill leachates, *Toxicity, *Daphnia, *Bioassay, Trout, Salmon, Residual oxygen bioassay, Municipal wastes, Costs.

Leachate from municipal refuse was analysed for acute toxicity using Daphnia pulex, rainbow trout (Salmo gairdneri) and sockeye salmon (Oncorhynchus nerka) as test organisms. Procedures used in conducting the daphnia bioassay are detailed. The 3 1/2 year testing program was designed to compare daphnia bioassays with standard fish bioassays and residual oxygen bioassays (ROB). Toxicity test results using daphnia are a good indicator of municipal landfill leachate toxicity, comparing very favorably to parallel test results obtained using the standard static 96-hr fish bioassay. Daphnia toxicity results obtained did not compare nearly as well with parallel ROB determination. This may be related to problems in the ROB testing. The regression analyses showed that zinc played an extremely important role as a determinant of daphnia toxicity, accounting for over 90% of observed variations. No disadvantages were seen in using daphnia rather than standard fish bioassay procedures. There are distinct advantages in the areas of total cost and test simplicity. (Moore-IVI)
W84-02727

GAS CHROMATOGRAPHY IN WATER ANALYSIS-I; ORGANIC PROFILES OF WATER SOURCES,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
P. Burchill, A. A. Herod, K. M. Marsh, C. A. Pirt, and E. Pritchard.
Water Research, Vol. 17, No. 12, p 1891-1903, 1983. 9 Fig, 2 Tab, 17 Ref.

Descriptors: *Gas chromatography, *Water analysis, *Organic compounds, Water treatment, Water sources, Potable water.

A method has been developed and used extensively for the routine chromatographic scanning of water sources for trace organic compounds. The method involves solvent extraction of the water with dichloromethane, followed by analysis of the concentrated extract by gas chromatography on a glass SCOT capillary column with flame ionization detection to yield a water profile. Over 600 extracts from rivers, canals, reservoirs and various stage of water treatment, collected between January 1979 and October 1980 as part of a potability study, were examined. The profiles were quantified using n-paraffin standards and a computerized data system. Components were detected at levels as low as 0.01 micro g/l in the water samples. A Kratos MS-30 double-beam mass spectrometer equipped with a DS-50 data system was used in conjunction with gas chromatography to identify types in over 60 of the organic extracts. Components were generally identified at levels as low as 0.1 micro g/l in the water samples. Many components did not give molecular ions and reference spectra were generally unavailable. In such cases, accurate mass measurement using the double-beam technique, which allowed the calculation of atomic compositions for fragment and molecular ions, was particularly valuable. (Author's abstract)
W84-02731

GAS CHROMATOGRAPHY IN WATER ANALYSIS-II; SELECTIVE DETECTION METHODS,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
P. Burchill, A. A. Herod, K. M. Marsh, and E. Pritchard.
Water Research, Vol. 17, No. 12, p 1905-1916, 1983. 10 Fig, 6 Tab, 24 Ref.

Descriptors: *Gas chromatography, *Haloforms, *Herbicides, *Chlorophosphate esters, Flame photometry, Raw water, Water treatment.

Gas chromatographic methods using selective detectors have been applied successfully to the determination of haloforms, herbicides and chlorophosphate esters in water extracts. Electron capture detection has been used for the determination of the four haloforms, $CHCl_3$, $CHCl_2Br$, $CHClBr_2$

and CHBr3 in pentane extracts. The very low detection limits render both the extracts and calibration solutions highly susceptible to contamination, and precautions necessary for their handling and storage are described. Mass spectrometric single ion monitoring of gas chromatographic effluents has been used for the determination of the herbicides MCPA, MCPB and Mecoprop in methylated ether extracts. Possible interference from other components of the water extracts is discussed, and it is concluded that more than one ion should be monitored for each herbicide to minimize the interference. A flame photometric method involving detection at 528 nm has been developed for the determination of chlorophosphate esters in dichloromethane extracts. The method is extremely specific for phosphorus compounds, but some interference from sulfur compounds may be observed. This can be minimized by the use of high efficiency capillary columns. Detection limits and linear response ranges for the methods are given, and detector selectivities are discussed. Typical chromatograms are shown, and representative results for raw and treated waters are also given. (Author's abstract)
W84-02732

A COMPARATIVE STUDY OF THE CONCENTRATION OF POLYNUCLEAR AROMATIC HYDROCARBONS BY OPEN CELL POLYURETHANE FOAMS,
National Water Research Inst., Burlington (Ontario).
B. K. Afghan, R. J. Wilkinson, A. Chow, T. W. Findley, and H. D. Gesser.
Water Research, Vol. 18, No. 2, p 9-16, 1984. 1 Fig, 6 Tab, 31 Ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *Water analysis, Aromatic compounds, Hydrocarbons, Extraction, Costs.

The concentration of dissolved polynuclear aromatic hydrocarbons (PAH) using open cell polyurethane foams is described. Parameters affecting the concentration of PAH have been optimized including the types of polyurethane foams, flow rates, volume of sample, eluting solvents, etc. It is possible to extract PAH at parts per trillion (pg ml/l) levels in natural waters and the method can be modified to analyze dissolved PAH from environmental samples. Significant amounts of PAH were retained by particulate matter in the samples and were not extracted by polyurethane foam or other solid extractants. The use of polyurethane foam provides advantages over other solid absorbents particularly when large samples are analyzed on a routine basis by offering high flow rates, good capacities and low costs and over solvent extraction for the same reasons as well as being insoluble, easily separable and non-polluting. Since very little weight of polyurethane is needed, the material cost is very low and the extracted samples can be easily transported. (Moore-IVI)
W84-02736

A MODIFICATION OF THE TRENT INDEX FOR USE IN DENMARK,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
M. M. Andersen, F. F. Riget, and H. Sparholt.
Water Research, Vol. 18, No. 2, p 145-151, 1984. 9 Fig, 2 Tab, 30 Ref.

Descriptors: *Denmark, *Invertebrates, *Pollution index, Water pollution, Stream pollution, Asellus, Chironomus, Bioindicators, Europe.

The central part of Jutland, which is cultivated alluvial lowland, was chosen for the study. The sites which were investigated covered a broad spectrum of running water types in Denmark. All together, 149 samples of macroinvertebrates were collected on 4 occasions during the span of one year. The samples were collected at 72 sites in 25 streams distributed within 17 watersheds. Based on the macroinvertebrates, a new pollution index has been devised which can be used as a surveillance system in Danish streams. The index is inspired by the Trent Index although it was necessary to incorporate two new principles: Asellus aquaticus and Chironomus sp. are used as negative taxa, with a negative influence on the index value; and the taxonomic groups have been replaced by establishing positive and negative index groups, where the number of negative index groups is subtracted from the number of positive. Thus, the utility of the basic principle, increasing pollution affecting decreasing numbers of taxonomic groups, is enhanced. The index was designed for Denmark, but the streams in Holland and the lowland of Germany and England are quite similar to those in Denmark; the index may therefore be applicable to the whole North European lowland. (Moore-IVI)
W84-02744

A PROCEDURE FOR ENRICHING AND CLEANING UP RHODAMINE B AND RHODAMINE WT IN NATURAL WATERS, USING A SEP-PAK C18 CARTRIDGE,
Nederlands Inst. voor Onderzoek der Zee, Texel.
R. W. P. M. Laane, M. W. Manuels, and W. Staal.
Water Research, Vol. 18, No. 2, p 163-165, 1984. 3 Tab, 11 Ref.

Descriptors: *Rhodamine B, *Rhodamine WT, *Tracers, *Adsorption, Dyes, Dye releases.

An enrichment and clean-up procedure is described for Rhodamine B and Rhodamine WT in natural waters. Sep-pak C18 cartridges were used to adsorb the Rhodamine dyes from aqueous solutions. Complete desorption of Rhodamine B and Rhodamine WT on the Sep-pak was achieved. The concentration of the dyes could be increased more than a 100-fold. The concentration of Rhodamine B in the North Sea during a tracer experiment was measured using three different methods. The Sep-pak procedure gave lower concentrations of Rhodamine B than the direct fluorometric measurements. It is concluded that when the Sep-pak procedure is used to enrich Rhodamine dyes there is no interference from salts, pH, pigments and natural fluorescence on the dye fluorescence. This enrichment and clean-up procedure has advantages in tracer experiments. With the same amount of dye it is possible to measure for a longer period. For short experiments, less dye needs to be used. (Author's abstract)
W84-02745

DETERMINATION OF CATIONIC SURFACTANTS IN WASTE- AND RIVER WATERS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
V. T. Wee.
Water Research, Vol. 18, No. 2, p 223-225, 1984. 1 Fig, 3 Tab, 6 Ref.

Descriptors: *Surfactants, *Water analysis, *Wastewater analysis, *Liquid chromatography, Colorimetry, Thin-layer chromatography, Quarternary ammonium compounds.

Three analytical methods were used to determine the concentration of ditallow dimethyl ammonium chloride (DTDMAC), a cationic surfactant in river water, sewage influent and sewage effluent. The methods consist of: high performance liquid chromatography (HPLC) coupled with conductimetric detection; a colorimetric procedure commonly referred to as disulfine blue active substance (DBAS); and a combination of DBAS and thin-layer chromatography (TLC). The DBAS was less specific and sensitive than either DBAS-TLC or HPLC and therefore tended to overestimate the concentration of DTDMAC in environmental samples. DBAS-TLC and HPLC are comparable in specificity although HPLC is more sensitive and requires significantly less time to perform than either DBAS or DBAS-TLC. The overall advantages of the HPLC procedure make it an attractive analytical technique to accurately measure the concentration of DTDMAC in the environment. The HPLC method can conveniently provide a very good estimate of the contribution of high molecular weight quarternary ammonium compounds in environmental matrices. This accurate estimate will be useful in evaluating the environmental impact of quarternary ammonium compounds. (Moore-IVI)
W84-02749

CULTURED RAINBOW TROUT AND HUMAN CELLS EXPOSED TO PCBS IN THE EVALUATION OF CYTOTOXICITY OF AQUATIC POLLUTANTS,
Quebec Univ., Montreal. Dept. de Chemie.
F. Denizeau, and M. Marion.
Water Research, Vol. 18, No. 2, p 247-251, 1984. 2 Fig, 19 Ref.

Descriptors: *Toxicity, *Trout, *Polychlorinated biphenyls, *Bioassay, Water pollutants, Cell culture, Protein, DNA, RNA, Growth.

A class of pollutants which represents a considerable threat to the aquatic and ultimately human life includes compounds of low acute toxicity, low water solubility or high lipid affinity and high bioaccumulation capacity. As part of program aimed at developing a bioassay system capable of detecting the toxicity of water contaminants including those of low water solubility and low acute toxicity, rainbow trout gonad cells (RTG-2) and human skin epithelial cells (NCTC 2544) were selected for testing material. RTG-2 and NCTC 2544 cells were exposed to Aroclor 1254 at 100 ppb and 1 ppm for a complete cell growth cycle. The following parameters were measured as indicators of toxic effects: total protein, DNA and RNA content; the incorporation of tritiated thymidine in DNA and C-14 uridine in RNA. The trout cells showed a greater sensitivity to Aroclor 1254 than did the human cells. With the RTG-2 system, effects have been consistently noted as soon as 6 days after the onset of exposures (total RNA, incorporation of thymidine and uridine) whereas with human cells, there was still no effect after 7 days. The know sensitivity of the aquatic organisms, in particular the rainbow trout, as well as the low cost, versatility and efficiency of cells in culture make possible the development of a unique and invaluable bioassay system for toxicity testing based upon the use of cultured trout cells in vitro. (Moore-IVI)
W84-02752

SAMPLING FREQUENCY FOR WATER QUALITY MONITORING: MEASURES OF EFFECTIVENESS,
Nichols Applied Management, Edmonton (Alberta).
D. Casey, P. N. Nemetz, and D. H. Uyeno.
Water Resources Research, Vol. 19, No. 5, p 1107-1110, October, 1983. 9 Ref.

Descriptors: *Monitoring, *Water quality, *Sampling frequency, Sampling, Water quality standards.

Selecting the sampling frequency is one of the most important tasks in the design of a regulatory water quality monitoring program. Two quantitative measures of the effectiveness of different sampling frequencies are proposed; these measures are intended to be used at the preliminary program design stage. The goal of the program is assumed to be the detection of violations of water quality standards. The first measure, M', gives the expected proportion of violations that will be detected. The second, M", is the ratio of the expected number of violated samples over the expected number of violations. By setting the average sampling interval equal to the average duration of a violation, the expected number of violated samples would equal the expected number of violations, since the errors caused by missing some violations and counting others more than one would tend to cancel out. The measures M' and M" will assist industrial dischargers and environmental agencies in the more effective design and assessment of water quality monitoring programs. (Moore-IVI)
W84-02757

POLYMERS TO SELECTIVELY REMOVE OXIDIZING ANIONS FROM NON-OXIDIZING ANIONS AND NO3(-) AND NO2(-) FROM POLLUTED WATERS,
Kansas State Univ., Manhattan. Dept. of Chemistry.
S. J. Chiou, T. Gran, C. E. Meloan, and W. C. Danen.

Analytical Letters, Vol. 16, No. A13, p 951-956, September, 1983. 3 Tab, 3 Ref.

Descriptors: *Nitrates, *Nitrites, *Polymers, Water analysis, Pollutant identification, Water pollution, Resins.

A copolymer of 1-phenyl-2-diethylaminoethyl-p-aminobenzoate and polyvinylbenzyl chloride was found to have a greater capacity for NO3(-) and NO2(-) than a previously reported nitron polymer but did not react as rapidly. The resin is readily regenerated with NH4OH or NH4Cl and is not affected by the pH of the water over the range of 4-10. A copolymer of 1-(4'-nitrophenyl)-2-diethylaminoethyl-p-nitrobenzoate and polyvinylbenzyl chloride was found to react nearly as fast as the nitron polymer and have a larger capacity for NO3(-) and NO2(-). (Author's abstract)
W84-02780

STATISTICAL APPROACH FOR DECIDING IF MUSSELS (MYTILUS EDULIS) HAVE BEEN COLLECTED FROM A WATER BODY POLLUTED WITH TRACE METALS,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Chemistry.
J. D. Popham, and J. M. D'Auria.
Environmental Science and Technology, Vol. 17, No. 10, p 576-582, October, 1983. 1 Fig, 7 Tab, 23 Ref. NSERC grants G0161 and G0507.

Descriptors: *Mussels, *Bioindicators, *Trace metals, *Statistical methods, Water pollution, Estuarine environment, Monitoring, Zinc, Lead, Heavy metals, British Columbia.

Two necessary requirements of monitoring programs are to be able to detect pollution effects against the background of the natural variability found in sentinal organisms and then to decide whether such an effect is sufficiently different from a reference population, e.i., represents a population of organisms from a polluted environment. A statistical approach is developed to decide whether specimens of Mytilus edulis (mussels), a sentinel organism for heavy metals, are inhabiting a water body that can be classified as polluted. Principal component analysis was applied to the correlation matrix of variates (Mn, Fe, Cu, Zn, and Pb concentrations, dry weight, wet weight, shell length, day/season of collection) measured in specimens collected monthly over a 12-month period from an unpolluted location in an estuary of southwestern British Columbia. Using the principal component scores determined for this set as a reference, a procedure is developed to decide whether similarly measured variates and related principal component scores for mussels collected from other locations indicate if these other water bodies were 'polluted' with heavy metals. Mussels which have very high concentrations of lead, zinc, copper, or iron indicate industrial pollution of the surrounding water. Using this method, it was possible to locate an area having less Zn and Pb pollution that the reference area, as well as areas with much higher levels. (Moore-IVI)
W84-02789

ANION CONTENT OF SNOW BY SUPPRESSED AND NON-SUPPRESSED ION CHROMATOGRAPHY,
Montana State Univ., Bozeman. Dept. of Chemistry.
D. R. Jenke, P. K. Mitchell, and G. K. Pagenkopf.
Journal of Chromatographic Science, Vol. 21, p 487-489, November, 1983. 2 Fig, 1 Tab, 14 Ref. EPA grant R-805935.

Descriptors: *Snow, *Chemical analysis, *Ion chromatography, Acid precipitation, Rocky Mountains, Chlorides, Nitrates, Sulfates, Air pollution, Fallout.

Both suppressed and non-suppressed ion chromatographic methods were employed in the analysis of snow sampled from the Rocky Mountains for Cl(-), NO3(-), and SO4(2-). By suppressed ion chromatography the concentration of these anion was found to be less than 1 mg/liter. These concentrations are lower than what can be determined using commerically available non-suppressed systems. To overcome this problem, the samples may be preconcentrated or a larger sample used. Due to complications arising on using a larger sample, in the absence of preconcentration, each sample must be analyzed twice by the non-suppressed ion chromatographic procedure. By comparison, the suppressed procedure is a factor of 10 more sensitive than this non-suppressed procedure. Even so, the results obtained by each of these procedures are not significantly different one from the other. (Baker-IVI)
W84-02798

VELOCITY PLOTS AND CAPTURE ZONES OF PUMPING CENTERS FOR GROUND-WATER INVESTIGATIONS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
J. F. Keely, and C. F. Tsang.
Ground Water, Vol. 21, No. 6, p 701-714, November-December, 1983. 14 Fig, 4 Tab, 13 Ref. DOE contract DE-AC03-76SF00098.

Descriptors: *Groundwater pollution, *Water quality, *Pumping, Velocity plots, Plumes, Wells, Monitoring, Water quality control, Computers, Groundwater movement.

Several easily mastered methods for rapid estimation of the impact of pumping centers on nearby contaminant plumes are described and illustrated through the use of examples. Items considered include manual plots of velocity distributions; radial flow time-series models; and the RESSQ model, which is an expanded version of the radial flow time-series model, capable of incorporating the natural flow velocity and also capable of simulating more complex situations where several pumping wells and contaminant sources need to be evaluated simultaneously. While manual plots are easily constructed for a single well, use of computerized codes is much more efficient for more complex situations. Such codes can be devised to show not only the spatial distribution of contaminants, but also the contaminant concentration history at selected points. Use of such plots can help the field investigator select the most appropriate solutions to pollution problems. (Baker-IVI)
W84-02817

PYROLYSIS GAS CHROMATOGRAPHY-MASS SPECTROMETRY OF POLYCHLORINATED BIPHENYLS ON SEDIMENT,
University of Southern Mississippi, Hattiesburg. Dept. of Chemistry.
K. D. McMurtrey, N. J. Wildman, and H. Tai.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 6, p 734-737, December, 1983. 2 Fig, 5 Ref.

Descriptors: *Polychlorinated biphenyls, *Sediments, Lake sediments, Mass spectrometry, Gas chromatography, Pyrolysis, Soil analysis, Analytical methods.

Preliminary experiments have been performed, directed to assessing the use of pyrolysis/gas chromatography/mass spectrometry in determining polychlorinated biphenyl contamination of soils and sediments. In these experiments pyrolytic desorption at 1000 degrees C during 10 sec. was used to completely replace more lengthy wet chemical manipulations. The top 6-8 cm of sediment was collected from a lake in about 5 ft of water using a grab sampler. The total ion chromatogram displayed a number of large and small peaks with retention times between 3 and 10 min, while the reconstructed gas chromatograms were primarily composed of incompletely resolved clusters of peaks with retention times between 7.5 and 10 min. Mass spectrum of the 360 amu RCG peak eluting at 9.5 min shows evidence for chlorinated biphenyls with 4 and 6 chlorine atoms. It is clear that PY/GC/MS is able to demonstrate the presence of spiked PCBs on air-dried sediment at about the 10 ppm level. (Baker-IVI)
W84-02836

DETERMINATION OF MANGANESE AT NG/ML LEVELS IN NATURAL WATERS BY DIFFERENTIAL PULSE POLAROGRAPHY,
Pisa Univ. (Italy). Ist. di Chimica Analitica.
M. P. Colombini, and R. Fuoco.
Talanta, Vol. 30, No. 12, p 901-905, 1983. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Chemical analysis, *Natural waters, *Differential pulse polarography, Manganese, Estuarine environment, Iron, Chromium, Polarography.

An electrochemical procedure based on differential pulse polarography (DPP) is described for the determination of manganese at ng/ml levels. Chromium and iron can also be determined if the buffer system is changed. Polarographic determination of manganese in unbuffered natural waters was subject to strong interference because the chromium and iron signals overlap the manganese signal. In addition, the presence of nitrate enhances the chromium interference. In the proposed procedure based on DPP, citrate-borate, ascorbate-borate, and ascorbate-ammonia-ammonium chloride buffers allow the determination of ng/mg levels of manganese, manganese and iron, and manganese and chromium respectively, in natural waters. (Baker-IVI)
W84-02911

MONITORING OF EXCESS TEMPERATURE FIELDS,
Dansk Hydraulisk Inst., Hoersholm.
J. B. Nielson.
Water Science and Technology, Vol. 15, No. 10, p 165-175, 1983. 7 Fig, 5 Ref.

Descriptors: *Monitoring, *Water temperature, *Powerplants, *Effluents, Thermal pollution, Hydrology, Estuaries, Model studies, Environmental effects, Feasibility studies.

In the process of monitoring the impacts resulting from thermal pollution from power plants, the excess heat is widely used as an indicator. One single environmental standard may however not be appropriate to cover the different physical aspects of locations for such plants. A number of aspects have to be considered in monitoring of excess temperature: location and depth of meaurement; frequency of measurements; scanning technique to be used; other tools such as models. Investigations are divided into feasibility studies, site investigations (including modelling), and monitoring programs. Prediction and modelling of future impact, and the control and verification of actual impact, are closely interrelated. The monitoring program should ideally commence some years before start-up of the plant, and continue for 3-5 years after implementation, followed by reevaluations. The presentation is elucidated with examples of recent Danish monitoring programs, including a study of the expansion of the coal/oil fired powerplant Enstedvaerket from 200 MW to 860 MW, and a possible extension of Vestfraft powerplant in the estuary Ho Bay. Different locations demand different approaches in defining a monitoring program. (Moore-IVI)
W84-02942

5B. Sources Of Pollution

CHANGE IN THE CONCENTRATION OF SEVERAL TYPES OF PHOSPHATE FROM UPSTREAM TO DOWNSTREAM IN THE HAN RIVER ON THE KOREAN PENINSULA,
Hiroshima Univ. (Japan). Dept. of Environmental Studies.
K. Nakane, S.-U. Hong, and H.-S. Kang.
Japanese Journal of Limnology, Vol. 44, No. 3, p 190-205, July, 1983. 9 Fig, 6 Tab, 25 Ref.

Descriptors: *Phosphates, *Rivers, *Water pollution sources, *Han river, *Korea, Detergents, Fertilizers, Industrial wastes, Domestic wastes, Seasonal variations.

Sixteen sampling sites from upstream to downstream in the Han River on the Korean Peninsula

were used to investigate the concentration of nine types of phosphate throughout the four seasons in 1978-1979. All types of phosphate increased in concentration from upstream to downstream, especially in the Seoul City area. The ratio of particulate organic phosphate to total phosphate was constant from upstream to downstream irrespective of the total phosphate concentration level, suggesting that the plankton biomass increased in proportion to the total phosphate concentration. The ratio of dissolved ortho and hydrolizable phosphate to dissolved total phosphate increased from several percent in the upstream area to more than 90% in the downstream region. Results of phosphate analysis in thirteen tributaries showed that the increasing concentrations of phosphate, particularly ortho and hydrolizable phosphate from the upstream to downstream, were caused by drainage water from cultivated land in the middle reaches and mainly by domestic and industrial waste water in the downstream areas, which were heavily contaminated by fertilizer or synthetic detergent. (Baker-IVI)
W84-02480

SELECTIVE CHEMICAL LEACHING OF IRON, MANGANESE, COPPER AND CADMIUM IN RIVER SEDIMENT AT THE ERUPTION OF MT. ONTAKE,
Nagoya Univ. (Japan). Water Research Inst.
Y. Kitano, C. Tomiyama, and R. Fujiyoshi.
Japanese Journal of Limnology, Vol. 44, No. 3, p 215-224, July, 1983. 9 Fig, 5 Tab, 13 Ref.

Descriptors: *Volcanoes, *Leaching, *Heavy metals, *Mount Ontake, Japan, Iron, Manganese, Copper, Cadmium, Rivers, Water pollution sources, Hydrogen ion concentration, Sediments.

A large amount of volcanic ejecta was absorbed by rivers around Mt. Ontake (Japan) due to its volcanic eruption on October 28, 1979. The partitioning of iron, manganese, copper and cadmium into mineral fractions of river sediments has been investigated by a selective chemical leaching technique. The diagenetic behavior of these heavy metals in the river sediments was researched as a case study. The heavy metals in the river sediments were originally contained only in sulfide and silicate lattice fractions. Through the contact of sediment with water and air, the chemical form of iron changed to sulfate and hydroxide, manganese in the sulfide fraction mostly changed to the chemical forms of sulfate and silicate, and cadmium in sulfide fraction disappeared and was found only in the silicate fraction. The chemical form of copper did not change through the diagenetic process. The increase in river water pH after volcanic eruption presumably causes the dissolution of heavy metals. But the dissolved heavy metals are assumed to be removed effectively from the waters through coprecipitation with iron hydroxide which is formed due to the oxidation of iron and the pH increase in the river waters. (Moore-IVI)
W84-02482

LEACHING LOSSES OF NUTRIENTS IN OIL PALM PLANTATIONS DETERMINED BY TENSION LYSIMETERS,
Nigeria Inst. for Oil Palm Research, Benin City. Chemistry Div.
U. Omoti, D. O. Ataga, and A. E. Isenmila.
Plant and Soil. Vol. 73, No. 3, p 365-376, 1983. 1 Fig, 5 Tab, 18 Ref.

Descriptors: *Fertilizers, *Leaching, *Nigeria, *Oil palms, *Nutrients, Nitrogen, Potassium, Calcium, Magnesium, Sulfates, Chlorine.

The leaching losses of both native and applied fertilizer nutrients in young and adult oil palm plantations on an acid sand soil at the NIFOR Main Station in Central-Southern Nigeria were studied using alundum tension lysimeters placed at 60- and 150-cm depths. There were no significant differences in the leaching of the applied fertilizers between the young and adult plantations. Under an annual rainfall of 1923 mm, the average leaching losses of the applied fertilizer nutrients from both plantations were 11 kg N(34%), 10 kg K(18%), 43 kg Ca(172%), 14 kg Mg (60%), 12 kg SO4-S (14%) and 77 kg Cl (141%) per hectare. The average losses of the native nutrients were 43 kg N, 16 kg K, 144 kg Ca, 32 kg Mg, 67 kg SO4-S and 142 kg Cl. Although large, the annual losses of the native N, K, Ca and Mg represented only 6, 15, 4 and 3% respectively of the total initial amounts (total N and exchangeable cations) of these elements in the soil to a depth of 60 cm. Compared with losses under annual crops in areas of West Africa with much lower rainfall, the losses of the applied N, K and S are moderate. Taking into account the leaching losses and the annual nutrient requirements of an adult oil palm, the present annual rates of fertilizer application are inadequate and need to be increased for good vegetative growth and optimum bunch yield. (Moore-IVI)
W84-02506

TEMPORAL TRENDS TOWARD STABILITY OF HUDSON RIVER PCB CONTAMINATION,
New York State Dept. of Environmental Conservation, Albany.
R. J. Sloan, K. W. Simpson, R. A. Schroeder, and C. R. Barnes.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 4, p 377-385, 1983. 2 Fig, 2 Tab, 32 Ref.

Descriptors: *Polychlorinated biphenyls, *Fate of pollutants, *Water pollution, *Hudson River, *New York, Fish, Silt, Algae, Invertebrates, Multiplate residues, Aroclor.

Polychlorinated biphenyls (PCB) were used in the manufacture of electrical equipment at two sites on the upper Hudson River. PCB concentrations were determined in water, multiplate residues and fish from the upper and lower Hudson River from 1977 to 1981. Multiplate residues, composed of silt, algae and invertebrates collected on hardboard plates over a 5-wk exposure period, reflect PCB availability in the water column. Each year, all three sample types from the most highly contaminated portion of the upper Hudson River had higher PCB concentrations than those from the lower river by factors ranging from 1.4 to 4.8. Both river sections exhibited declining PCB concentrations over the course of the study, but the upper river response was more pronounced. For water, the greatest measured declines occurred in 1980 and 1981. The multiplate residues and fish experienced their initial significant declines in 1979. The multiplate sample concentrations rose sharply in 1981. Changes in total PCB for multiplate samples and fish were due almost entirely to changes in concentration of Aroclor 1016. From 1978-1981 there was no appreciable change in the concentration of Aroclor 1254. The surge of PCB in 1981 multiplate samples is not consistent with the water and fish data, and the reason for the increase is not known. (Moore-IVI)
W84-02530

UPTAKE AND CONCENTRATION FACTOR OF AROCLOR 1254 IN AQUATIC ORGANISMS,
Georgia Univ., Athens. Dept. of Food Science.
J. A. Gooch, and M. K. Hamdy.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 4, p 445-452, 1983. 3 Fig, 36 Ref. OWRT grant ERC 01-80-Ga.

Descriptors: *Polychlorinated biphenyls, *Aroclor, *Bioaccumulation, Ecosystems, Toxicity, Mosquitos, Bacillus, Guppies, Cichlids, Fish.

The uptake and concentration factor (CF) of Aroclor 1254 was followed in selected organisms representing a simple aquatic ecosystem. Four organisms were used: cells of PCB-resistant Bacillus spp., mosquito larvae (Aedes aegypti), guppies (Lebistes reticulatus), and cichlids (Cichlasoma facetum). For the two Bacillus strains, maximum uptakes of 22 and 24% were reached ater 72 hr incubation with CFs of 28 and 21. Very little effect on growth was noted. For mosquitos, the uptake by 3 day old larvae gradually increased to 5.1% after 96 hr; for 5 day old larvae there was a maximum uptake of 6.2% at 48 hr, declining to 2.6% at 96 hr. The CF of 3 day old larvae increased gradually to 553 after 96 hr. whereas that of 5 day old larvae reached its maximum of 638 at 48 hr. Guppies exposed to Aroclor 1254 all died within 3 wk. Direct uptake increased gradually to 3.6% after 96 hr with a CF of 198. The heads and fins of cichlids accumulated the greatest percentage of PCB (62.5% and 17.0%, respectively after 24 hr exposure). The CF tended to increase over time. (Moore-IVI)
W84-02532

HEAVY METAL CONTENT OF RAINWATER IN GENEVA, NEW YORK, DURING LATE 1982,
Hobart and William Smith Colleges, Geneva, NY. Dept. of Chemistry.
C. F. Aten, J. B. Bourke, and J. C. Walton.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 5, p 574-581, November, 1983. 5 Tab, 20 Ref.

Descriptors: *Rain, *Heavy metals, *Rural areas, *Geneva, *New York, Cadmium, Calcium, Magnesium, Zinc, Iron, Particulate matter, Fly ash, Fallout, Acid rain.

A determination was made of precipitation-borne fallout in a rural setting. Rainwater samples were collected at a relatively isolated site near Geneva, New York, from September through December of 1982 and at another similar site starting in late November. Samples were analyzed for 19 metallic elements, NO3(-), SO4(-2), pH and conductance. Six soil samples were analyzed for cadmium by inductively coupled plasma emission spectrometry. The acidity of the rainwater varied from pH 3.6 to 7.3 with overall average 4.2 in agreement with others for this region. In heavy rains the water collected later in the storm was generally less acidic and freer of other ions than the first rain to fall. The concentration of cadmium was surprisingly large, especially in some samples where values up to 1.52 micrograms/mL were found. The apparent cadmium fallout in rain is either a very recent development or simply a fluctuation. No correlation was found between cadmium and any other ionic species. The source of the cadmium fallout was not determined. (Baker-IVI)
W84-02537

IS THERE A BEST MODEL STRUCTURE; I. MODELING THE FATE OF A TOXIC SUBSTANCE IN A LAKE,
Canada Centre for Inland Waters, Burlington (Ontario).
E. Halfon.
Ecological Modelling, Vol. 20, No. 2/3, p 135-152, November, 1983. 2 Fig, 9 Tab, 13 Ref.

Descriptors: *Model studies, *Mathematical models, *Fate of pollutants, *Lakes, Pollutants, Food chains, Ecosystems, Lake sediments, Feeding, Fish, Benthos.

Three system methods are used to compare the internal connectivity and structural properties of two sets of fate models of a toxic substance in a lake. One set of models has six state variables and the second has ten. The methods used are a complexity measure c, an analysis of recycling perturbation following the addition or deletion of links among state variables, and a computation of direct and indirect flows among state variables. The purpose is to develop a model which reflects the cycling properties of an ecosystem without having too many unnecessary parameters. In ecological models many flows can not be measured and the parameterizations are uncertain. This fact is particularly true for fate models, where information on movement of toxic substances among compartments is often minimal. One set of models represents a general class of models, such as EXAMS, where no food chain transfer is included in the model structure and the second set represents a class of models with a food chain. Results show that for a six-compartment model, the best structure M4 includes several flows within the water column and the sediment compartments, including sedimentation and feeding of fishes from benthos. For the ten-compartment models, depending on the information available from the real system, structures T2 and T3 are the best. These two

structures include food chain transfers but no excretion or sediment uptake by fish and benthos. These models have the best network structure to represent the lake of interest. The models are insensitive to structural perturbation, and their structure minimizes any possible inappropriate parameterization because of alternative indirect connections among state variables. (Author's abstract)
W84-02539

FOREST ECOSYSTEM SO4-S INPUT-OUTPUT DISCREPANCIES AND ACID RAIN: ARE THEY RELATED,
B. Haines.
Oikos, Vol. 41, No. 1, p 139-143, 1983. 1 Tab, 38 Ref. NSF grant DEB 7714981.

Descriptors: *Acid rain, *Forests, *Sulfur, Sulfates, Tropical regions, Sulfuric acid, Soil chemistry, Water pollution sources, Rain forests, Biomass, Path of pollutants.

The inputs and outputs of SO4-S have been estimated for seven terrestrial ecosystems in the Americas. Five of the systems, an agricultural watershed, and two deciduous forests in the Southeastern United States, and a Central and a South American rainforest had an excess of inputs over outputs. The reported discrepencies were between +4 and +11 kg/ha/yr. Hypotheses to explain excess of inputs over outputs include: accumulation of S in biomass; accumulation of S in soil; conversion of SO4-S to organic S compounds which leave the system in drainage water; conversion of SO4-S to volatile S compounds which leave as gases; and estimation errors. Acid rain occurs at both rain forest sites. If the S were volatilized out of the forest, oxidized in the atmosphere to SO4, then washed out of the atmosphere by rain, the resulting quantity of H2SO4 would be sufficient to account for the rainfall acidity observed in the field in Central America. (Moore-IVI)
W84-02555

CHLORIDE POLLUTION OF THE GREAT LAKES,
Wisconsin State Lab. of Hygiene, Madison.
W. C. Sonzogni, W. Richardson, P. Rodgers, and T. J. Monteith.
Journal of the Water Pollution Control Federation, Vol. 55, No. 5, p 513-521, May, 1983. 3 Fig, 6 Tab, 57 Ref.

Descriptors: *Chlorides, *Great Lakes, *Water pollution sources, Industrial wastes, Phosphorus, Lake Michigan, Lake Superior, Lake Huron, Lake Erie, Lake Ontario.

Current estimates of chloride inputs to the Great Lakes from various sources are summarized. Changes that have occurred over past years are reviewed. The rate of change of chloride inputs to the Great Lakes, especially industrial discharges, seems to have stabilized or decreased in recent years. Nevertheless, chloride inputs are still high compared to the early 1900s and have resulted in elevated chloride concentrations in the lakes. Although near steady state chloride concentrations have been nearly reached in the lower lakes, concentrations in the upper lakes, which have flushing times on the order of hundreds of years are still building up. This is most dramatic in Lake Michigan, whose concentration is predicted to increase over the long term from 8 mg/L to nearly 20 mg/L if current loads are maintained. Observations from other lakes that have experienced conservative ion increases indicate that chlorides do not present an immediate high risk problem relative to others facing the lakes. Future phosphorus loads to the Great Lakes from municipal point sources should be reduced over 50% compared to mid-1970 levels. The extent to which the lakes actually respond to this reduction should provide valuable insight into the influence that conservative ions may have on water quality and a strategy for prudent management of chloride inputs to the Great Lakes, especially Lake Michigan. (Baker-IVI)
W84-02569

AEROSOL RELEASE OF CYANOPHAGES AND COLIFORMS FROM ACTIVATED SLUDGE BASINS,
North Carolina Univ. at Greensboro. Dept. of Biology.
R. E. Cannon.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1070-1074, August, 1983. 6 Tab, 9 Ref.

Descriptors: *Wastewater treatment facilities, *Aerosols, *Public health, *Coliforms, *Cyanophages, Activated sludge process, Wind, Temperature, Solar radiation, Seasonal variations, Bacteriophage, Greensboro, North Carolina.

The study was conducted at two secondary wastewater treatment plants in Greensboro, North Carolina. The North Buffalo plant processes 95% domestic and 5% industrial wastes. The South Buffalo Plant processes 30% domestic and 70% industrial wastes. LPP-cyanophages detected by the most probable number (MPN) method were found more frequently at South Buffalo than at North Buffalo. The fact that cyanophages are detected in chlorinated, sand filtered effluent indicates how hardy these organisms are compared to coliforms. The diffused aeration at North Buffalo caused little aerosol release of both coliforms and cyanophages. Mechanical aeration at South Buffalo produced extensive aerosolization of both cyanophages and coliforms from the activated sludge. Both the mechanical air sampler and Petri dish methods were effective in collecting cyanophages within 10 m of the tanks at South Buffalo. Isolated, non-systematic samplings by the Petri dish method, detected cyanophages in the air to 75 m downwind of the activated sludge basins at South Buffalo. Wind was the most important environmental factor that determined aerosol spread of cyanophages and coliforms. Solar radiation probably influenced survival of cyanophages and coliforms during the summer in the open Petri dishes, but the enclosed air sampler was able to detect cyanophages throughout the summer. Aerosols released from wastewater treatment plants may be a potential health hazard for personnel working at the plants and for individuals living nearby. Cyanophages can be used to rapidly and inexpensively measure the tendency towards aerosol spread of viruses at different locations. (Baker-IVI)
W84-02574

FATE OF TOXIC ORGANIC COMPOUNDS IN WASTEWATER TREATMENT PLANTS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
A. C. Petrasek, I. J. Kugelman, B. M. Austern, T. A. Pressley, and L. A. Winslow.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1286-1296, October, 1983. 3 Fig, 5 Tab, 48 Ref.

Descriptors: *Wastewater treatment, *Organic compounds, Fate of pollutants, Activated sludge processes, Arochlor 1254, Heptachlor, Lindane, Toxaphene, Phenols, Pesticides, Phthalates, Polynuclear aromatic hydrocarbons, Priority pollutants.

The partitioning of 22 of the semivolatile organic priority pollutants in conventional wastewater systems was quantified. In the pilot-scale treatment sequence no changes in the concentrations of the compounds studied were observed as a result of either the sewer simulator or the aerated grit chamber. Removal in the primary clarifiers, computed from mass balances, was quite variable between groups but was relatively consistent within any given class of compounds. Partitioning to the primary sludge was an undefined function of the octanol/water partitioning coefficient. The overall removals by the treatment sequences were excellent, most of which were greater than 97%. Lindane, bis-(2-ethylhexyl)phthalate, di-n-butylphthalate, and pyrene are notable exceptions. The concentration factors for the primary sludge samples were significantly higher than those for the return activated sludge, but to keep these data in proper perspective the mass balance data must be cross referenced. A typical publicly owned treatment works, with the processes studied, significantly reduced the concentrations of the 22 organic priority pollutants, with the above noted exceptions. It is also noted that although some of the compounds were biodegraded, many of the chemicals studied were present in the sludges in very high concentrations. The fate of these materials in the solids handling processes is not known. (Baker-IVI)
W84-02598

LAKE PHOSPHORUS LOADING FROM SEPTIC SYSTEMS BY SEASONALLY PERCHED GROUNDWATER,
Geological Survey, Reston, VA.
R. J. Gilliom, and C. R. Patmont.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1297-1305, October, 1983. 1 Fig, 5 Tab, 29 Ref.

Descriptors: *Path of pollutants, *Phosphorus, *Lakes, *Water pollution sources, *Septic wastewater, Leaching, Soil properties, Groundwater pollution, Eutrophication, Domestic wastes, Drainage basins.

A case study was made of Pine Lake to determine how phosphorus is moving to lakes from old septic systems in glacial-till terrain. A regional analysis of septic-system P loading and this case study indicate that loadings of P to some lakes in the Puget Sound region are attributable to old septic systems. Effluent from each of the old systems studied was reaching the lake in perched groundwater flowing through soil overlaying less permeable glacial till. However, movement of more than 1% of effluent P to the lake was found to be rare. The loading of P to the lake by old septic systems is probably associated with only a few systems located in areas where soils are persistently saturated during the winter season. The probable relationship between septic-system P loading and the occurrence of persistently saturated soils indicates a possible explanation in addition to system age for the empirical relationship between the two. The relationship may be due in part to the location of old systems in seasonally wet areas compared to newer systems. Regulation and enforcement of construction practices were less stringent in the 1940s and 50s. (Baker-IVI)
W84-02599

HISTORY OF LAKE ACIDIFICATION AND AIR POLLUTION STUDIED ON SEDIMENTS IN SOUTH FINLAND,
Helsinki Univ. (Finland). Dept. of Botany.
K. Tolonen, and T. Jaakkola.
Annales Botanici Fennici, Vol. 20, No. 1, p 57-78, 1983. 19 Fig, 7 Tab, 87 Ref.

Descriptors: *Acid precipitation, *Air pollution, *Water pollution sources, *Finland, *Sediments, *Lake acidification, Paleolimnology, Lead radioisotopes, Diatoms, Varves, Lead, Zinc, Titanium, Cadmium, Copper, Mercury, Heavy metals, History.

Diatom and chemical analyses of the sediments of small oligohumous forest lakes on granitic bedrock with undisturbed (two lakes) or only slightly disturbed (two lakes) watersheds gave evidence of acidification by air-borne substances (acid precipitation). The varve (one lake) and lead-210 chronology (two lakes) indicated that this process commenced less than three decades to a few years ago. At the same time there was a considerable increase in the contents and sedimentation rates of lead, zinc, titanium, cadmium, copper and mercury. In the case of lead, however, the increase in deposition stated during the latter half of the 19th century. These changes were largely connected with accelerated atmospheric input. Element enrichment factors were calculated by dividing the concentrations in the surface sediments by the values in sediments deposited 150-200 years ago. After correction for input due to erosion from the catchment area, the enrichment factors were: Pb +28, Cd +9.4, Ca -7.1, Ti + 3.1, Zn +3.0, Hg +2.7, Fe -2.1, Mn and Al -2.0, Cu +1.6, Ni +1.2. (Author's abstract)
W84-02609

THE DEGRADATION OF DYESTUFFS: PART I, PRIMARY BIODEGRADATION UNDER ANAEROBIC CONDITIONS,
ETAD, Basel (Switzerland).
D. Brown.
Chemosphere, Vol. 12, No. 3, p 397-404, 1983. 3 Tab, 11 Ref.

Descriptors: *Dye industry wastes, *Degradation, Anaerobic conditions, Biodegradation, Dyes, Sludges, Sediments, Silt.

A method is described for measuring the primary biodegradability of water soluble dyestuffs under anaerobic conditions and gives the results obtained on 22 dyes of commercial significance. The dyestuffs tested included mordant blue 13, mordant black 9, basic red 18, acid yellow 151, direct red 7, acid red 114, direct blue 15, direct yellow 12, reactive black 5, acid blue 113, direct black 19, direct black 22, reactive blue 19, acid blue 80, acid blue 25, basic blue 22, basic green 4, direct yellow 11, reactive blue 21, basic blue 3, acid orange 3, and basic yellow 28. The results for the 4 azo and 6 diazo dyes show that virtually all the participating laboratories found very substantial biodegradation, and bearing in mind that the inoculum source and precise experimental details were different in each lab, these results are in good agreement with each other. With the two poly-azo dyes the results for direct black 19 all showed a moderate to substantial degree of degradation, but with direct black 22 the spread of results was from 0 to 100%. The four anthraquinone dyes showed results ranging from scarcely degraded in the case of acid blue 80, to substantial degradation for the other three. Of the remaining 6 miscellaneous dyestuffs no conclusions could be drawn with basic green 4. The other five all showed a moderate level of degradation. The results show that with the single exception of acid blue 80, all the dyestuffs tested can show a substantial degree of color removal and thus it seems a reasonable conclusion that the breakdown of dyestuff in the environment is likely to be initiated under anaerobic conditions. (Baker-IVI)
W84-02623

TCDD IN BOTTOM SEDIMENTS AND EEL AROUND A REFUSE DUMP NEAR AMSTERDAM, HOLLAND,
Amsterdam City Environmental Health Research Lab. (Netherlands).
H. Heida.
Chemosphere, Vol. 12, No. 4/5, p 503-509, 1983. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Organochlorine pesticides, *Sediment contamination, *Waste dumps, *Netherlands, Chlorinated hydrocarbons, Chlorobenzenes, Chlorophenols, Hexachlorocyclohexane, Dioxins, Industrial wastes, Water pollution sources, Eels, Bioaccumulation, Partition coefficients.

A refuse dump located north of Amsterdam (Netherlands), heavily contaminated with organochlorine waste compounds from 2,4,5-T production, pollutes the surrounding area through the main drainage canal. The dump is situated in a wetland of peat soil character used for dairy farming. Chlorobenzenes, chlorophenols, hexachlorocyclohexanes and the chlorodioxins, mainly 2,3,7,8-TCDD, were identified in the sediments. Analysis of bottom sediments in the drainage canal was positive for 2,3,7,8-TCDD at concentrations beween 50 and 5,000 ppt on a dry weight basis. The lowest concentrations occurred in a small pond about 1 km from the dump. Analysis of sediment samples by two laboratories showed a fairly good agreement. Eel caught from the same aquatic habitat had about 1 ppt of 2,3,7,8-TCDD in its tissue. This was lower than calculated levels, based on knowledge of water-sediment partition coefficient and biological accumulation factors. (Moore-IVI)
W84-02624

FATE OF 1,3,6,8-T4CDD IN AN OUTDOOR AQUATIC SYSTEM,
Manitoba Univ., Winnipeg. Dept. of Soil Science.
R. L. Corbet, D. C. G. Muir, and G. R. B. Webster.
Chemosphere, Vol. 12, No. 4/5, p 523-527, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Fate of pollutants, *Tetrachlorodibenzo-p-dioxin, Sediments, Vegetation, Fish, Pesticide residues, Fathead minnows, Trout, Water pollution, Dioxins.

Outdoor ponds (5200 + or - 185 L) were treated with 0, 100, 250, and 1000 ng/L C-14 1,3,6,8-tetrachlorodibenzo-p-dioxin (1,3,6,8-T4CDD). Air, water, sediment, vegetation, and fish samples were taken at regular intervals over 90 d, with a final sample at 355 d. Within 96 h, 89-96% of the C-14 had moved from the water column (t 1/2 = 25 h). Volatile loss of 1,3,6,8-T4CDD was greatest during the first day after treatment. Labelled material also moved into the sediment attaining steady state levels of 0, 4.7, 10.3, and 20.5 ng/g dry wt respectively after 8 d. In a separate laboratory study, fathead minnows and rainbow trout took up C-14 1,3,6,8-T4CDD rapidly, and clearance rate constants were 0.211 + or - 0.023/d and 0.158 + or - 0.014/d. (Author's abstract)
W84-02625

A QUANTITATIVE WATER, AIR, SEDIMENT INTERACTION (QWASI) FUGACITY MODEL FOR DESCRIBING THE FATE OF CHEMICALS IN LAKES,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, M. Joy, and S. Paterson.
Chemosphere, Vol. 12, No. 7/8, p 981-997, 1983. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Fugacity, *Lake sediments, *Fate of pollutants, Mathematical models, Advective flow, Volatilization, Resuspension, Deposition, Burial, Air pollution.

A mathematical model was formulated to describe the fate of a chemical in a sediment-water-air system as may occur in a contaminated lake. Equilibrium is quantified using the fugacity concept and fugacity capacities. Expressions are written in the form of fugacity equations with a common D parameter, or kinetic coefficient, for processes of advective flow, volatilization, sediment resuspension, deposition and burial, wet and dry atmospheric deposition, and degrading reactions. By describing these diverse processes by identical mathematical expressions, their relative rates are more easily compared and algebraic manipulation is facilitated. Several analytical solutions are possible: a steady state condition; a water and sediment unsteady state condition; a steady state water, unsteady state sediment condition; and a steady state sediment, unsteady state water condition. Numerical solution can also be used to treat more complex situations when emissions or rate parameters vary with time. (Moore-IVI)
W84-02626

A QUANTITATIVE WATER, AIR, SEDIMENT INTERACTION (QWASI) FUGACITY MODEL FOR DESCRIBING THE FATE OF CHEMICALS IN RIVERS,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, S. Paterson, and M. Joy.
Chemosphere, Vol. 12, No. 9/10, p 1193-1208, 1983. 6 Fig, 3 Tab, 1 Ref.

Descriptors: *Fugacity, *Fate of pollutants, *Rivers, *Mathematical models, Sediment-water interactions, Air-water interactions, Model studies, Solute transport, Particulates, Resuspension, Advection, Volatilization, Deposition.

The QWASI fugacity model has been reformulated in a coordinate system to apply to rivers. An analytical solution describes the steady state fate of a chemical in a river of constant properties in which there is interaction with air and sediment. Transport and transformation processes included are advective flow (in solution and in association with suspended particles), reaction in sediment and water, sediment deposition, resuspension and burial, and air-water exchange processes of volatilization, adsorption, and wet and dry deposition with particulate matter. The equations are formulated in terms of fugacities with common transport and transformation parameters. The model may be useful for estimating the distance downstream that a particular chemical emission may persist, thus assisting regulatory measures concerned with defining acceptable emissions. A steady state sectioning model version is mathematically equivalent to the analytical solution. An unsteady state version is illustrated for the case of a river which is recovering from previous contamination. In most cases it will be valid to assume that the water will adopt a steady state concentration relative to the sediment. The models can be used to quantify the behavior of chemicals in rivers and to obtain insights into the dominant transport and transformation process and thus help to assess the likely impact on such aquatic systems. (Moore-IVI)
W84-02630

A RADIOTRACER STUDY OF AIR-WATER EXCHANGE OF SYNTHETIC ORGANIC COMPOUNDS,
Texas A and M Univ., College Station. Dept. of Chemistry.
E. Atlas, A. Velasco, K. Sulliva, and C. S. Giam.
Chemosphere, Vol. 12, No. 9/10, p 1251-1258, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Air-water interfaces, *Path of pollutants, *Organic compounds, Salinity, Henry's Law, Chlorination, Pollutants.

A simple radiotracer technique determined Henry's Law Constants for some prevalent organic pollutants including hexachlorobenzene, PCBs, and di-n-butyl phthalate. The results obtained with this technique were in good agreement with the few other data available on the subject. The data suggest that the partition coefficient of PCB decreases slightly with increasing degree of chlorination. The increase in salinity from distilled water to seawater increases the partition coefficients of HCB, BCP, and PCB by 1.4, 1.5, and 2.1 times, respectively. Naturally occurring organics dissolved in seawater or lake water caused no appreciable effect on the measured partition coefficients of the test compounds. (Baker-IVI)
W84-02632

PARTICULATE FLUX AT THE BOTTOM OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W84-02633

MICROBIAL METABOLISM OF N-PHENYL-1-NAPHTHYLAMINE IN SOIL, SOIL SUSPENSIONS, AND AQUATIC ECOSYSTEMS,
Syracuse Research Corp., NY.
A. Rosenberg.
Chemosphere, Vol. 12, No. 11/12, p 1517-1523, 1983. 6 Fig, 12 Ref. AF contract F49620-77-C-0027.

Descriptors: *N-Phenyl-1-naphthylamine, *Microbial degradation, *Fate of pollutants, Aquatic environment, Soil microorganisms, Wastewater, Amines, Additives, Metabolism.

N-Phenyl-1-naphthylamine (PNA) is a lubricant additive widely used in Air Force operations. The chemical may be introduced into the aquatic or terrestrial environments as a result of accidental spills, waste discharge effluent from manufacturing plants, or during its use and disposal. PNA was degraded and mineralized in nonsterile aquatic and terrestrial samples. Degradation in unsupplemented sewage and lake water was detected in 3 to 6 days with half-lives of 5 and 10 days, respectively. In sewage and lake water supplemented with a readily degradable carbon source, degradation began in 1 and 5 days with half-lives of 2 and 8 days, respectively. Sewage samples converted between 20 and 30% of C-14 labeled PNA to labeled CO2 in 35 days while lake water samples reached 10% conversion to labeled CO2 in 12 days. Soil samples and soil suspensions converted from 15 to 35% of

C-14-PNA to labeled CO2 in 11 days. PNA was microbiologically converted in lake water to two products that were tentatively identified by gas-liquid chromatography and mass spectroscopy as dihydroxy and N-acetyl derivatives. The extent and rate of microbial attack on the compound were dependent on the amount of organic matter present. The disappearance of the parent compound may not indicate removal of the hazardous potential of the molecule from the environment. (Moore-IVI)
W84-02634

POLLUTION SOURCE ANALYSES USING 1-DIMENSIONAL TIME SERIES,
Illinois State Environmental Protection Agency, Springfield.
D. J. Schaeffer, C. Corley, and H. Chien.
Environmental Management, Vol. 7, No. 5, p 421-426, 1983. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Water pollution sources, *Lake Holiday, *Illinois, *Bacteria, Nutrients, Effluents, Reservoirs, Coliforms, Streptococcus, Artificial lakes.

Lake Holiday, a human-made recreational lake in northern Illinois, was threatened with closure due to high bacterial levels. A factorially designed experiment with multivariate responses was developed to study and identify the main sources of pollution. Data on total coliform, fecal coliform, fecal streptococci, dissolved oxygen, pH, ammonia-N, total phosphorus, nitrate/nitrite-N were analyzed using regression models describing dam spillway loads as a function of source loads and time. The results suggest that the relationships among source, time, and load are complex, even though only two sources account for most of the lake's loading. Stevens Brook, which receives the discharge from the Somonauk Sewage Treatment Plant, and Somonauk Creek, which is the major drainage, contribute high loads of bacteria and nutrients to the lake. The influent loads contributed to the lake are discharged at the dam over about 4 weeks. (Author's abstract)
W84-02642

CHLORINATED ACIDS AND CHLORAL IN DRINKING WATER,
Massachusetts Univ., Amherst. Dept. of Chemistry.
P. C. Uden, and J. W. Miller.
Journal of the American Water Works Association, Vol. 75, No. 10, p 524-527, October, 1983. 3 Fig, 2 Tab, 18 Ref. DOE contract DE-AC02-77EV-04320.

Descriptors: *Chlorination, *Drinking water, Organic compounds, Dichloroacetic acid, Trichloroacetic acid, Chloral hydrate, Chloroform, Water treatment.

The quantitation of three compounds, dichloroacetic acid (DCAA), trichloroacetic acid (TCAA) and chloral, in addition to chloroform, was carried out using samples from a municipal water supply system. Concentrations of DCAA and TCAA were similar in the range of 30 to 160 micrograms/liter and comparable to those for chloroform. Those of chloral were lower by a factor of about 10 but were still readily measurable by using the microwave plasma emission detector (MED). All of these compounds could also be measured with other detection systems that are selective for halogenated compounds. All four of the above compounds resulted from municipal chlorination. The concentrations of these organics depended on the amount of natural organics in the untreated water. If residual chlorine were present after chlorination, the concentrations depended on the contact time between organics and residual chlorine. Qualitative studies showed that all of the chlorinated compounds found in finished waters were also formed in the chlorination of soil fulvic acids. (Baker-IVI)
W84-02677

NONPOINT WATER QUALITY CONTRIBUTIONS FROM LAND USE,
Arizona Univ., Tucson. School of Renewable Natural Resources.
D. C. Wilkin, and R. W. Jackson.
Journal of Enviromental Systems, Vol. 13, No. 2, p 127-136, 1983-84. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Nonpoint pollution sources, *Land use, *Water pollution sources, Phosphorus, Nitrates, Water quality, Sediment barriers, Floodplains, Watershed management, Trap efficiency, Reservoirs.

Stream loads of total phosphorus and nitrate-nitrogen were studied as a function of land use in a midwestern watershed of 5,853 sq km by means of ordinary least squares (OLS) regression analysis. The purpose was to test the general hypothesis that the variance in chemical water quality from undefined sources is a function of land use within the watershed, and to begin to study the hypothesis that land use near the stream is more important than land use far from the stream in affecting water quality from nonpoint sources. Results support both hypotheses. Further, these results suggest the importance of considering the means by which chemicals are delivered to the stream. Nitrate-nitrogen and phosphorus can apparently both be purposely intercepted, but by different means because of their different delivery systems. Nitrate-nitrogen can be intercepted by removal of fast-growing floodplain crops, and phosphorus by sediment barriers outside the floodplain. Evidence also suggests trap efficiency in reservoirs is important in improving downstream water quality. (Author's abstract)
W84-02683

BEHAVIOR OF COPPER IN SOUTHEASTERN UNITED STATES ESTUARIES,
Skidaway Inst. of Oceanography, Savannah, GA.
H. Windom, G. Wallace, R. Smith, N. Dudek, and M. Maeda.
Marine Chemistry, Vol. 12, p 183-193, 1983. 10 Fig, 14 Ref. DOE contract DE-AS09-76EV00890.

Descriptors: *Copper, *Path of pollutants, Savannah River, Ogeechee River, Estuaries, Estuarine environment, Georgia, Sediment transport, Salinity, Nearshore processes, Seasonal variation.

Discharges of the Savannah and Ogeechee Rivers vary seasonally with highest runoff generally occurring between January and June. During low runoff dissolved copper concentrations in the river are low. Exchangeable copper on particles and colloids also may be low. Therefore, release in the low salinity region of the estuaries is small. Because of the low discharge, however, the estuarine-nearshore residence time of water is relatively long and copper release from bottom or resuspended sediment is significant. During low discharge, high salinity waters are closer to shore and overlie more copper rich fine grain sediments which provide a greater source for release. Higher temperatures and increasing reaction rates during summer low runoff conditions may also enhance copper release, leading to a higher zero salinity copper concentration intercept of the tangent to the high salinity portion of the mixing curve. During high runoff, riverine dissolved and possibly exchangeable copper concentrations are greater than during periods of low runoff. Significant amounts of copper are released from particles and/or colloids at low salinity possibly followed by some copper removal. Removal, however, is offset and exceeded by copper release from estuarine sediments. Because of the short nearshore residence time of water during high discharge, sediment release is less significant, resulting in a lower zero salinity copper concentration intercept of the tangent to the high salinity portion of the mixing curve. (Baker-IVI)
W84-02690

REQUIREMENTS FOR MODELING TRACE METAL PARTITIONING IN OXIDIZED ESTUARINE SEDIMENTS,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2L.
W84-02692

SOURCES OF NITRATES IN GROUNDWATER OF THE COASTAL PLAIN OF ISRAEL; EVOLUTION OF IDEAS,
Ministry of Agriculture, Tel-Aviv (Israel).
D. Ronen, Y. Kanfi, and M. Magaritz.
Water Research, Vol. 17, No. 11, p 1499-1503, 1983. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Nitrates, *Groundwater pollution, *Israel, Water pollution sources, Fertilizers, Coastal Plain Aquifer, Wastewater, Soil chemistry, Irrigation water, Organic matter.

In 1981 the Coastal Plain aquifer of Israel had an average nitrate concentration of 53 m/l of NO3. This phreatic aquifer supplies 25% of the water consumed in the country through 1600 pumping wells. This problem is especially severe because Israel has only one integrated water system that supplies water for municipal, agricultural and industrial use. The quantitative nitrogen balance of the aquifer is analyzed based on the reconstructed average nitrate trends in groundwater. Most of the nitrates found today in the aquifer reached the water table in the period 1930-1960, which suggests that the mineralization of the organic matter in the soil and unsaturated zone was the main source of nitrate pollution. The steep rise in the average nitrate concentration of groundwater over the last 50 years was the inevitable result of the agricultural development of the area. If no large transient nitrate reservoir exists in the unsaturated and water table zones, it is expected that the average nitrate content of groundwater will decrease with time. The slight nitrogen input to groundwater from fertilizers, sewage, animal excreta, irrigation water, rainwater and solid waste, suggests that previous prediction models and managerial and technical recommendations should be reevaluated. (Murphy-IVI)
W84-02700

FECAL COLIFORM DISAPPEARANCE IN A RIVER IMPOUNDMENT,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
J. J. Gannon, M. K. Busse, and J. E. Schillinger.
Water Research, Vol. 17, No. 11, p 1595-1601, 1983. 4 Fig, 7 Tab, 25 Ref.

Descriptors: *Fecal coliforms, *Reservoirs, *Sedimentation, Balancing reservoir, Bacteria, Lake restoration, Drainage basins, Storm drainage, K rates, Solar radiation, Ypsilanti, Michigan, Huron River, Ford Lake, Chick equation, Channel flow.

During the summer of 1979, intensive fecal coliform disappearance studies were conducted in Ford Lake, an artificial main river impoundment at the lower end of the Huron River drainage basin, downstream from Ypsilanti, Michigan. Ford Lake receives all upstream flow of 2072 sq km of drainage in addition to fourteen storm drains which discharge directly into the lake. The lake has a surface area of about 32,515,000 sq m, a volume of about 151,510,000 cu m, a length of about 3658 m and a mean depth of 4.66 m. In the more active upper section of the lake, the mean depth is 0.9 to 1.83 m. During dry weather, using a dye tracer for timed collection, an overall daytime fecal coliform disappearance K rate of 0.4/h was calculated from a water column in support of the hypotheses that sedimentation of fecal coliform organisms attached to solid particles partially accounts for the high fecal coliform disappearance rate in the channel area of the lake. From the rooftop results it is seen that reduced light K rates are substantially lower than the normal sunlight K rates, indicating natural level substantially influences the fecal coliform disappearance rate. Two types of wet weather were documented: where a substantial increase in flow occurred due to an isolated upriver storm; and as a result of two different storm events in the Ford Lake area itself. In both cases, Ford Lake was effective in substantially reducing the large fecal coliform contribution. (Murphy-IVI)
W84-02706

RATES OF DISSOLUTION OF CONSTITUENT ORGANIC CONTAMINANTS FROM COAL LIQUEFACTION OIL FILMS INTO WATER,

Oak Ridge National Lab., TN. Environmental Sciences Div.
S. E. Herbes, G. R. Southworth, and C. P. Allen.
Water Research, Vol. 17, No. 11, p 1639-1646, 1983. 5 Fig, 2 Tab, 27 Ref. DOE contract W-7405-eng-26.

Descriptors: *Oil pollution, *Coal liquifaction, *Organic compounds, *Dissolution, Phenols, Anilines, Naphthalene, Solubility, Coal liquids, Oil spills, Partition coefficient, Turbulence, Fate of pollutants.

Commercial coal liquifaction facilities are likely to be constructed within the coming decade. Because plants will require large amounts of water, they may be sited along major rivers, so that spills of liquid product into rivers are a possible environmental hazard. To facilitate development of a model for dissolution of toxic contaminants from synthetic coal liquids in the event of an accidental riverine spill, dissolution rates from oil films overlying water in a stirred laboratory extractor were measured by solvent partitioning and gas chromatography. Major water-soluble contaminants identified in five coal liquids were phenol, aniline and their C1-C3 alkylated derivatives. First-order rate constants for approach to equilibrium were related to the oil-water partition coefficient in an inverse nonlinear relationship; data agreed well with a two-film model. Overall mass transfer coefficients varied nearly 1000 from phenol to naphthalene in one oil. Oil-phase mass transfer coefficients were inversely related to oil viscosity. Under riverine turbulence conditions in which spilled oil is not dispersed by mixing into the water column, phenols and anilines in coal liquids will dissolve far more rapidly than one- and two-ring aromatic hydrocarbons. Other weathering processes may alter behavior of a spilled coal liquid and will complicate application of the dissolution model. (Moore-IVI)
W84-02711

EVALUATING A MASS TRANSFER MODEL FOR THE DISSOLUTION OF ORGANICS FROM OIL FILMS INTO WATER,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth, S. E. Herbes, and C. P. Allen.
Water Research, Vol. 17, No. 11, p 1647-1651, 1983. 3 Fig, 2 Tab, 13 Ref. DOE contract W-7405-eng-26.

Descriptors: *Oil pollution, *Mass transfer, *Dissolution, Organic compounds, Mathematical models, Solubility, Oil-water interfaces, Oil spills, Partition coefficient, Synthetic oils.

Because the environmental impact of an oil spill is determined in part by concentrations of toxic materials in the oil and by the rates at which those toxicants move from the oil to the water, the ability to predict the rates at which various toxic constituents of synthetic oils are transferred from floating oil films to the underlying water is helpful to understanding the potential environmental effects of synthetic oil spills. A mass-transfer model analogous to one used to describe the volatilization of organics from natural waters was used to describe the dissolution of constituent organics from a floating oil film into the underlying water. The rate of dissolution of a substance from oil to water is highly dependent upon the partition coefficient, P. The partition coefficient also sets the maximum attainable aqueous concentration for a given initial concentration of the substance in the oil phase. Rates of dissolution were observed to vary with properties of the solute, P, the oil (viscosity, P, oil depth) and the environment (oil and water mixing, water depth). The observed rates of dissolution of chemicals from a low-viscosity oil (heptane) varied by a factor of about 10000 between the most rapidly and most slowly dissolving materials. (Moore-IVI)
W84-02712

MONITORING ANIONIC SURFACTANTS AT A SEA OUTFALL, HALIFAX HARBOUR, CANADA,
Dalhousie Univ., Halifax (Nova Scotia).
M. J. Gagnon.
Water Research, Vol. 17, No. 11, p 1653-1659, 1983. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Marine environment, *Anionic surfactants, *Halifax Harbor, Nova Scotia, Effluents, Monitoring, Tracers, Water pollution, Path of pollutants.

Anionic surfactants are typically introduced to the marine environment via outfall discharges. Monitoring of the concentration possibly can help to elucidate the behavior of these compounds and the effluent in the natural environment. Halifax Harbor and its natural extension, the Northwest arm, were chosen as sites for a detailed study of anionic surfactants in the marine environment because sewage discharge is not treated in any way. A concentration range between 1.0 and 200 micro g/l can be found in polluted areas. The highest concentrations were detected near the point source. In Halifax Harbor, high concentrations of surfactants are associated with the presence of rising plumes. Wind and tidal currents can affect both the spreading of these compounds and the waste field. Anionic surfactants can be used as tracers, in well defined effluents, but they possibly suffer a certain level of biodegradability. The proper choice of one or a combination of tracers may render wastewater effluent monitoring a routine and precise exercise when low concentrations of effluents are encountered in the marine environment. (Moore-IVI)
W84-02713

LABORATORY AND FIELD ANALYSIS OF PENTACHLOROPHENOL (PCP) ACCUMULATION BY SALMONIDS,
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and C. Y. Cho.
Water Research, Vol. 17, No. 12, p 1791-1795, 1983. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Trout, *Pentchlorophenol, *Bioaccumulation, Water pollution effects, Fish, Wood preservatives, Pesticides, Phenols, Lake Ontario.

Rainbow trout were fed diets containing 10-3000 micro g/kg pentachlorophenol (PCP) for up to 110 days to examine its accumulation. Fish fed the 10 micro g/kg diet maintained whole body levels of 2 micro g/kg PCP over the study period, while PCP levels in those fed the 3000 micro g/kg diet increased to 40 micro g/kg after 40 days, then decreased thereafter to 20 micro g/kg at the end of the study. The biological half-life of PCP in trout was estimated to be approximately 7 days. PCP concentrations in the liver and gall bladder of fish fed the 3000 micro g/kg diet were substantially higher than those monitored in the remainder of the fish. The PCP concentrations monitored in fish during the food uptake and elimination studies were not acutely toxic to trout. PCP levels in six species of fish representing two trophic levels from Lake Ontario were also monitored; most species contained 1-10 micro g/kg PCP. Rainbow trout collected in the Credit River had PCP levels averaging 24 micro g/kg. The results suggest the uptake of PCP from water would be a more important pathway for its accumulation by fish than its intake from food when viewed from an environmental perspective. Biliary excretion could represent a major clearance pathway for trout. (Moore-IVI)
W84-02722

EMPIRICAL RATE EQUATION FOR TRIHALOMETHANE FORMATION WITH CHLORINATION OF HUMIC SUBSTANCES IN WATER,
Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
K. Urano, H. Wada, and T. Takemasa.
Water Research, Vol. 17, No. 12, p 1797-1802, 1983. 12 Fig, 19 Ref.

Descriptors: *Trihalomethanes, *Chlorination, *Humic acids, Drinking water, Halogenated hydrocarbons, Water treatment, Sagami River, Japan.

Trihalomethane (THM) in drinking water is formed by chlorination of humic substances. The rates of THM formation in aqueous solution of humic acid were examined under various conditions. A rate equation was obtained empirically. The activation energy was obtained as 37 kJ/mol. To test the applicability of the proposed rate equation to the THM formation from actual river and lake waters, chlorination tests on a sample of river water were carried out. River water from Sagami River, whose total organic carbon concentration was 5.0 mg/l, was chlorinated at 20 C by dosing hypochlorite. The data fitted and could be expressed by the rate equation. THM concentrations in drinking water for each water distributing area can be predicted by this equation. Precursor in each water source can be characterized and variations with season and water teatment conditions can also be evaluated. (Moore-IVI)
W84-02723

ION EXCHANGE AND HYDROLYSIS OF TYPE A ZEOLITE IN NATURAL WATERS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
H. E. Allen, S. H. Cho, and T. A. Neubecker.
Water Research, Vol. 17, No. 12, p 1871-1879, 1983. 5 Fig, 6 Tab, 27 Ref.

Descriptors: *Zeolite, *Ion-exchange, *Hydrolysis, *Fate of pollutants, Trace metals, Cadmium, Copper, Nickel, Lead, Detergents.

Type A zeolite is a synthetic, crystalline aluminosilicate used as a builder in laundry detergents. The ion exchange behavior and hydrolysis rate of Type A zeolite were studied in a variety of artificial and natural surface water samples at zeolite A and trace metal concentrations characteristic of what could occur in receiving waters. Type A zeolite hydrolyzed extensively in the test waters at rates which were strongly dependent on hydrogen ion concentration. Half lives of 1-2 months were typical for waters at a neutral pH. The extent of trace metal ion exchange was low (<10%) for the metals Cd, Cu, Ni and Zn. Only lead is likely to be exchanged to an extent greater than 10% and then only in waters containing high (1 mg/l) levels of zeolite. Under typical conditions, zeolite concentrations will be much less and lead exchange will be considerably less than 10%. The use of the zeolite in detergents will result in little effect on the trace metal distribution of surface waters owing to the low degree of ion-exchange by the zeolite and its hydrolysis products. (Moore-IVI)
W84-02729

MODELLING NITRIFICATION EFFECTS ON THE DISSOLVED OXYGEN REGIME OF THE SPEED RIVER,
Gore and Storrie Ltd., Toronto (Ontario).
T. P. H. Gowda.
Water Research, Vol. 17, No. 12, p 1917-1927, 1983. 6 Fig, 3 Tab, 22 Ref.

Descriptors: *Nitrification, *Dissolved oxygen, *Speed River, *Ontario, Computer models, Nitrogenous oxygen demand, Biochemical oxygen demand, Photosynthesis, Aeration, Aquatic plants, Water pollution.

Field studies on nitrification in an 11 km stretch of the Speed River below Guelph (Ontario) are described. The data, collected during three intensive surveys in spring-summer 1976 and winter 1977, were used to calibrate and verify a steady-state dissolved oxygen (DO) model which incorporates the effects of carbonaceous and nitrogenous oxygen demand (CBOD and NOD), plant and algal respiration and photosynthesis, and reaeration. The model calibration result for one of the survey conditions includes comparisons between the corresponding observed and predicted values of CBOD, NOD and daily minimum and maximum DO. The comparisons of the first three sets of parameters were satisfactory, but the predicted maximum DO values were generally higher than the observations. The model verification results for two other survey conditions were somewhat similar to those of the calibration study. Predictions of the relative effects of various sinks on the minimum DO levels under one of the survey conditions indicate that instream nitrification alone causes a

DO deficit of about 4.5 mg/l; in contrast, the deficits due to CBOD and respiration were in the order of 1 mg/l only. The model was also used to predict spatial DO distributions under several streamflow and temperature regimes. For each case, computer runs were made with NOD concentrations resulting from a conventional secondary (i.e. non-nitrified) effluent and a nitrified effluent. The predictions indicate that the minimum DO level increases with an increase in streamflow and a decrease in temperature. In the case of non-nitrified effluents, anoxic conditions are predicted to occur at about 25 C when streamflow rates are lower than about 1 cu m/s; whereas in-plant nitrification would result in daily minimum DO levels of 4 mg/l or greater. The predictions also show the occurrence of two DO sags in the study stretch, one being mainly due to a high degree of nitrification, while the other is due to the combined effect of all of the DO sinks. (Author's abstract)
W84-02733

A CHEMILUMINESCENCE TECHNIQUE FOR STUDYING DYNAMIC BEHAVIOR OF TRACE ELEMENT SPECIES IN ENVIRONMENTAL SYSTEMS,
Maine Univ. at Orono. Dept. of Chemistry.
S. Amirhaeri, R. Koons, M. Martin, and H. Patterson.
Water Research, Vol. 18, No. 1, p 87-90, 1984. 4 Fig, 9 Ref. OWRT grant B-D16-ME.

Descriptors: *Chemiluminescence, *Adsorption, *Kinetics, *Trace elements, Chromium, Cobalt, Iron, Thermodynamics.

The technique of chemiluminescence (CL) has been used to study the kinetics of association of aqueous chromium(III) with iron oxide for Cr(III) concentrations in the ppb range. The results have been compared with atomic absorption experiments for Cr(III) concentrations in the ppm range. Further, the CL technique has been used to study the kinetics of reaction of Cr(III) with citrate ion. The CL technique when applied to kinetic studies has the advantage of being applicable in a variety of systems including those containing solid phases. No filtration is required, reducing the associated problems of contamination and adsorption and allowing studies to be made at environmentally reasonable concentrations of several trace elements. Currently the elemental species which can be studied using the CL technique at levels consistent with their natural concentrations include Cr(III), Co(II), and Fe(II). An important advantage of the CL technique is that the concentrations of only one species of an element can be monitored independently of the other forms of the element present. The combination of this technique for kinetic studies with equilibrium studies of simple systems of environmental relevance should lead to measurement of fundamental thermodynamic parameters and elucidation of the mechanisms of these reactions. (Moore-IVI)
W84-02741

INFLUENCE OF FLOW-RELATED EVENTS ON CONCENTRATION AND PHASE DISTRIBUTION OF METALS IN THE LOWER FRASER RIVER AND A SMALL TRIBUTARY STREAM IN BRITISH COLUMBIA, CANADA,
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
G. G. Geesey, L. Borstad, and P. M. Chapman.
Water Research, Vol. 18, No. 2, p 233-238, 1984. 3 Fig, 7 Tab, 20 Ref.

Descriptors: *Path of pollutants, *Heavy metals, *Flow, *Fraser River, *Still Creek, *British Columbia, Seasonal variation, Spring freshet, Copper, Nickel, Zinc, Sediments.

Spring freshet, an annual phenomenon in western Canada and the northwestern U.S., can substantially modify river and stream beds. Drainages are likely to mobilize considerable quantities of heavy metals which accumulate in bottom sediments of polluted regions during low flow periods. Samples of sediments were collected at three locations in order to study the effects of seasonal water flow variations on the concentrations of reactive and non-reactive copper, nickel, and zinc in surficial bottom deposits of the lower Fraser River and one of its more polluted tributaries, Still Creek. A substantial portion of the total copper, nickel and zinc in bottom sediments of the lower Fraser River and Still Creek were in reactive forms. Particulate rather than dissolved components were responsible for the bulk of the metal interactions within all of the sediments examined. Increased flow generally resulted in a loss of reactive copper, nickel and zinc from sediments of Still Creek and of reactive copper and zinc from sediments of the Fraser River. Decreased flow was accompanied by an increase in the levels of the reactive copper, nickel and zinc fractions in both systems. Flow-related processes appeared to influence concentration and phase distribution of the metals in these lotic environments. (Moore-IVI)
W84-02751

OBSERVATIONS ON THE CHEMICAL COMPOSITION OF RAIN USING SHORT SAMPLING TIMES DURING A SINGLE EVENT,
Hope Coll., Holland, MI. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W84-02772

CADMIUM UPTAKE AND DISTRIBUTION IN STICKLEBACKS RELATED TO THE CONCENTRATION AND METHOD OF EXPOSURE,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
J. Woodworth, and D. Pascoe.
Ecotoxicology and Environmental Safety, Vol. 7, No. 6, p 525-530, December, 1983. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Cadmium, *Path of pollutants, *Stickleback, Heavy metals, Absorption, Fish.

The uptake of cadmium by sticklebacks and its distribution between the body tissues was compared following two methods of exposure: natural exposure to the heavy metal in water, and direct intraperitoneal injection. Cadmium was detected in all organs examined with the highest levels occurring in the liver, gall bladder, kidney and spleen, respectively. The whole fish concentration factors showed a similar inverse relationship with exposure concentration to that recorded in previous studies. The levels in gut and gill were elevated following natural cadmium exposure, as expected as these organs could be major uptake sites of a poison from the water. Sticklebacks injected with about 5 micrograms Cd/g body weight retained about 60% of this dose 60 hours post-injection. The primary sites of retention were the liver, gall bladder, kidney and gut while the level in gills was rather low. (Baker-IVI)
W84-02777

THE ZONE OF FLOW ESTABLISHMENT FOR PLUMES WITH SIGNIFICANT BUOYANCY,
Salford Univ. (England). Dept. of Mathematics.
B. Henderson-Sellers.
Applied Mathematical Modelling, Vol. 7, p 395-398, December, 1983. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Plumes, *Buoyancy, Path of pollutants, Mathematical models, Flow establishment, Jets, Trajectory, Froude number.

In the problem of simulating plumes of water into lakes, of sewage into oceans or waste gases into the atmosphere, much work has been done by evaluating the trajectory characteristics by solution of sets of differential equations. The profile is assumed to be self-similar and Gaussian, a flow which is established approximately six stack diameters downstream. This is the zone of established flow (ZEF). In the short distance between the exit and the beginning of the ZEF (in the zone of flow establishment, ZFE), the flow develops from the 'top hat' profile at the source to the Gaussian profile at the beginning of the ZEF. The Gaussian profile, observed at the beginning of the ZEF, must be related to source 'top hat' parameter values. However, previously used formulae are approximations, being valid only for non-buoyant sources ('pure jets'). Extensions to sources of significant buoyancy are described in terms of the densimetric Froude number. (Moore-IVI)
W84-02781

THE ECOLOGY OF RUNNING WATERS NEAR ABERFELDY, SCOTLAND, IN RELATION TO A PROPOSED BARYTES MINE: AN IMPACT ASSESSMENT,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
B. D. Smith, A. A. Lyle, and P. S. Maitland.
Environmental Pollution (Series A), Vol. 32, No. 4, p 269-306, 1983. 5 Fig, 12 Tab, 58 Ref.

Descriptors: *Mining, *Barytes, *Environmental effects, *Scotland, *Water pollution sources, Wastewater disposal, Heavy metals, Lead, Zinc, Monitoring, Stream pollution, Barite, Sediments.

A proposal to mine barytes (barium sulfate) near Aberfeldy, Scotland has led to concern over the possible ecological effects. Associated with the barium are several toxic metals, notably zinc and lead. Unless care is taken during the development, it is likely that these may find their way into the local freshwater systems, and so into the River Tay. Initially, three hill streams (Camserney, Cluny and Frenich Burns) and the River Tay were chosen for research on the hydrology, chemistry and biology of the waters in this area. The most notable result found was the biological impoverishment of the Frenich Burn; this was due either to the burn being naturally more metalliferous than the other waters or that it has been significantly affected by road works and preliminary mining activities. A fourth stream (Middleton Burn), whose catchment is also highly metalliferous but free from such activities, was subsequently surveyed. Human activities in the Frenich catchment are likely to be major contributory factors to its impoverishment. An assessment was made of the impact of this mining development on the ecology of the local waters. The most serious hazard was thought to be contamination by toxic metals. Additionally, road works, the establishment of the mine and associated activities all present potential problems. The three main potential problems are sedimentation (due both to construction activities and the crushing and removal of the relatively insoluble barytes), heavy metal pollution, and organic pollution. In order to reduce the impact of road and site works construction procedures should be such as to keep the erosion and wash-out of loose materials into streams to the minimum. To prevent heavy metal contamination, it may be necessary to treat the effluent before discharge. Careful selection of the discharge site is also essential. Tentative water quality standards are suggested. A monitoring program should be developed coincidentally with the mining development and maintained at least during the early years, if not through the entire life of the mine. (Moore-IVI)
W84-02788

MESOCOSM EXPERIMENTS TO DETERMINE THE FATE AND PERSISTENCE OF VOLATILE ORGANIC COMPOUNDS IN COASTAL SEAWATER,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
S. G. Wakeham, A. C. Davis, and J. L. Karas.
Environmental Science and Technology, Vol. 17, No. 10, p 611-617, 1983. 4 Fig, 2 Tab, 47 Ref. EPA grants R80607212 and CR807795.

Descriptors: *Coastal waters, *Fate of pollutants, *Persistence, *Organic compounds, *Volatile compounds, Hydrocarbons, Chlorinated hydrocarbons, Aliphatic hydrocarbons, Seawater, Estuarine environment, Biodegradation, Seasonal variation.

Studies were carried out in experimental marine ecosystems to determine the fate and persistence of a series of volatile organic compounds in coastal seawater. A suite of aliphatic hydrocarbons, aromatic hydrocarbons, chlorinated C2-hydrocarbons, and chlorinated aromatic hydrocarbons, covering a wide range of water solubilities, volatilities, and susceptibilities to biological degradation, was added to the water column of the mesocosms at

concentrations typical of a moderately polluted estuary (0.2-4 micro g/L). Concentrations in the water column were followed for up to 2 months, under experimental conditions simulating winter, spring, and summer. Water column half-lives of the same compounds ranged from about 1 day to up to 4 weeks, depending on season and compound class. Volatilization appears to be the major process removing aromatic hydrocarbons, chlorinated C2-hydrocarbons, and chlorinated aromatic hydrocarbons during all seasons, with biodegradation also important for aromatic hydrocarbons in summer. Aliphatic hydrocarbons are quickly sorbed onto particulate matter and thus removed from the 'volatile' pool; biodegradation also affects the alkanes. (Author's abstract)
W84-02790

BIODEGRADATION OF THE MONOCHLOROBIPHENYLS AND BIPHENYL IN RIVER WATER,
Dow Chemical Co., Midland, MI. Environmental Sciences Research Lab.
R. E. Bailey, S. J. Gonsior, and W. L. Rhinehart.
Environmental Science and Technology, Vol. 17, No. 10, p 617-620, October, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Biodegradation, *Biphenyls, *Monochlorobiphenyls, Mineralization, Degradation, Fate of pollutants, Polychlorinated biphenyls.

The rates of primary biodegradation, as well as mineralization, of the three isomers of monochlorobiphenyl (MCB), biphenyl (BP), and 2,2',4,4'-tetrachlorobiphenyl (TCB) have been determined by using a river water dieaway test. Analysis of river water extracts by high-performance liquid chromatography showed the times for 50% degradation of parent MCBs were 2-3 days and 1.5 days for BP at initial concentrations of about 1 micro g/L. The unchlorinated ring degraded initially and after a 50-day incubation, approximately 50% of the theoretical C-14 labeled CO2 was recovered from the subsequent degradation of the chlorinated ring of the MCBs. The rate of biodegradation of higher concentrations was somewhat slower. No degradation of TCB was observed over 98 days under conditions of this test. (Author's abstract)
W84-02791

SUBSURFACE ORGANIC CONTAMINANTS,
J. Josephson.
Environmental Science and Technology, Vol. 17, No. 11, p 518A-521A, November, 1983. 2 Fig, 1 Tab.

Descriptors: *Groundwater movement, *Path of pollutants, Leaching, Waste disposal, Trichloroethylene, Decomposing organic matter, Halogenated hydrocarbons, Humic substances, Soil chemistry.

One subsurface contaminants of particular concern is trichloroethylene (TCE). The fate and transport of contaminants such as TCE are thought to depend on the sorptive nature of the soils, the geochemical conditions that may control biological or chemical transformation, and hydrodynamic characteristics of the aquifer. Where conditions do not favor transformation, sorption of the contaminant by the soil may be the dominant process. The capacity of an organic compound to adsorb and the intensity of its adsorption vary directly with the octanol/water partition coefficient and inversely with its solubility in water. In a field investigation of halogenated organic solutes, injections of these substances were made into a relatively uncontaminated portion of an unconfined sand aquifer in Ontario, above an existing landfill leachate plume. Over 9000 samplings have been taken thus far in this experiment to study groundwater transport of contaminants. The possibility that humic substances in soil could affect the subsurface aqueous behavior of organic contaminants is also being examined. Other possible reactions to consider include the transformation of halogenated hydrocarbons into volatile organosulfur compounds and transformation or mineralization by microorganisms. (Baker-IVI)
W84-02792

FRESHWATER ACIDIFICATION FROM ATMOSPHERIC DEPOSITION OF SULFURIC ACID: A CONCEPTUAL MODEL,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, S. A. Norton, and M. R. Church.
Environmental Science and Technology, Vol. 17, No. 11, p 541A-545A, November, 1983. 2 Fig, 19 Ref.

Descriptors: *Acid rain, *Model studies, Sulfuric acid, Acidification, Natural waters, Conceptual models, Environmental effects, Ecosystems.

A simple conceptual model is presented that incorporates only a few key processes which are felt to determine how aquatic ecosystems respond to acid deposition with respect to time. The model is based on the assumption that if the rate of acid deposition changes, a variety of constituents in both the terrestrial and aquatic systems will respond. The model has seven stages: preacidification stage - steady state prior to significant emissions or anthropogenic sulfur; undersaturated sulfate adsorption capacity; saturated sulfate adsorption capacity in soil; steady-state period of lake acidification; supersaturated sulfate adsorption capacity; recovery of the percent base saturation; and the stable period of lake recovery. The model can be used by defining the pertinent characteristics of each stage and identifying geographical regions that have those characteristics. (Baker-IVI)
W84-02793

PREDICTION OF BUFFER CATALYSIS IN FIELD AND LABORATORY STUDIES OF POLLUTANT HYDROLYSIS REACTIONS,
Portland State Univ., OR. Dept. of Environmental Science and Chemistry.
E. M. Perdue, and N. L. Wolfe.
Environmental Science and Technology, Vol. 17, No. 11, p 635-642, November, 1983. 7 Fig, 4 Tab, 15 Ref.

Descriptors: *Pollutants, *Hydrolysis, *Buffers, *Catalysis, Fate of pollutants, Water pollution, Natural waters.

A mathematical model, based on application of the Bronsted equations for general acid-base catalysis, has been developed for use in forecasting the maximum contribution of buffer catalysis in pollutant hydrolysis reactions. The predictive capacity of the model is utilized to examine the potential significance of buffer catalysis in selected buffers and in a nutrient medium, both typical of laboratory studies, as well as in natural waters of varying chemical composition. Buffer catalysis is predicted to be potentially significant in laboratory studies that use buffers at concentrations above 0.001 M to maintain constant pH; however, at the very low concentrations of Bronsted acids and bases in most aquatic environments, this phenomenon is probably insignificant. (Author's abstract)
W84-02794

PESTICIDE CONCENTRATIONS AND YIELDS IN RUNOFF FROM SILTY SOILS IN THE LOWER MISSISSIPPI VALLEY,
Agricultural Research Service, Baton Rouge, LA.Soil and Water Pollution Research Unit.
G. H. Willis, L. L. McDowell, C. E. Murphree, L. M. Southwick, and S. Smith, Jr.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 6, p 1171-1177, November-December, 1983. 12 Fig, 7 Tab, 17 Ref.

Descriptors: *Pesticides, *Runoff, *Sediment concentration, Storm runoff, DDT, DDE, Toxaphene, Trifluralin, Agricultural runoff, Nonpoint pollution sources, Tillage, Pesticide residues, Organic matter, Cotton, Mississippi Valley.

Toxaphene, DDT, DDE, trifluralin, and sediment concentrations in runoff from an 18.7-ha watershed, planted to continuous cotton (Gossypium hirsutum L.), were measured from 1973 through 1978 to determine pesticide and sediment yields. Storm pesticide yields for DDT, DDE, trifluralin, and toxaphene (in years when not applied) were linear functions of storm sediment yields. In 1974-1977 linear relationships between toxaphene and sediment yields were evident only when each year's data were examined according to periods of similar tillage and toxaphene application regimes. Annual pesticide yield was correlated with annual sediment yield only for DDT and DDE. In 1973-1978 clay concentration in runoff was a linear function of sediment concentration, bu sediment organic matter (OM) concentration was a nonlinear function of sediment concentration, due to OM enrichment at low sediment concentrations. In general, DDT and DDE concentrations in 1973-1978 and toxaphene concentration in 1973 and 1978 were linear functions of sediment OM concentration and of OM plus clay concentration but were nonlinear functions of sediment concentration. In years when toxaphene and trifluralin were applied (1974-1977 and 1973-1978, respectively) their concentrations did not correlate with sediment concentration. Except for DDE, mean annual pesticide concentration did not correlate well with mean annual sediment concentration. Soil residual pesticide concentration was not directly related to the amount applied each year. Wide ranging weather conditions probably caused variations in the relationship between loading rates and residual concentrations. (Moore-IVI)
W84-02795

OXIDATION DEGRADATION OF THE PISCICIDE SQUOXIN IN AERATED RIVER WATER,
North Carolina Agricultural and Technical State Univ., Greensboro. Dept. of Chemistry.
J. E. Oliver, C. N. Lamb, and R. H. Smith, Jr.
Journal of Agricultural and Food Chemistry, Vol. 31, No. 6, p 1178-1183, November-December, 1983. 7 Fig, 26 Ref.

Descriptors: *Organic compounds, *Oxidation, *Fate of pollutants, *Squoxin, Rivers, Piscicides, Chemical reactions.

Squoxin, a piscicide, rapidly decomposes in aerobic river water, but not in aerobic distilled water. The reaction has at least two requirements - oxygen and some component of river water. Oxidation of squoxin in river water, unlike its oxidation by most chemical agents, apparently produces an unstable hydroperoxide that fragments to 1,2-naphthoquinone and 1,2-naphthoquinone 1-methide. The former compound further decomposes to a number of other products whereas the latter compound instantly hydrates to form the relatively stable 1-(hydroxymethyl)-2-naphthol, which in turn decomposes producing formaldehyde and probably additional 1,2-naphthoquinone. (Baker-IVI)
W84-02796

LEAD LEVELS IN SNOW DUMPING SITES ALONG RIVERS IN DOWNTOWN WINNIPEG, MANITOBA, CANADA,
Winnipeg Univ. (Manitoba).
A. R. Lockery, T. Gavrailoff, and D. Hatcher.
Journal of Environmental Management, Vol. 17, No. 2, p 185-190, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Lead, *Snow removal, *Path of pollutants, *Winnipeg, *Manitoba, Assiniboine River, Red River, Snow dump, Sediments, Water pollution sources, Urban areas, Heavy metals.

Lead levels were determined in residual sediments from snow dumps in downtown Winnipeg. All samples taken within the dump sites showed significantly higher lead levels than the adjoining soils. There were also visible patterns and trends within the snow dump sediments which necessitate further interpretation. The Assiniboine dump site had not been used for dumping since the winter of 1976-1977, and yet it showed a much greater gradient between the low levels in the river and the dry zone than the Red River dump which continues is use. Both the Red River and the Assiniboine River have different flow regimes, but the findings indicate that over the period of one summer and fall the Red River sediments show a reduction of 83 mg/l or 32% while the smaller Assiniboine River shows a reduction of 205.3 mg/l in five years (71%) or 41 mg/liter in a year's time. There has been at both dumps no change in lead levels since

1974, indicating that the bond between lead and particulate matter is both strong and stable in the environment. Manitoba should consider adopting legislation to ban snow dumping within 150 ft of a waterway, as is the case in Ontario and Alberta. (Baker-IVI)
W84-02821

ASSESSMENT OF HUMAN EXPOSURE AND HEALTH RISK TO ENVIRONMENTAL CONTAMINANTS IN THE ATMOSPHERE AND WATER WITH SPECIAL REFERENCE TO CANCER,
National Cancer Inst., Bethesda, MD. Div. of Cancer Cause and Prevention.
H. F. Kraybill.
Journal of Environmental Science and Health, Vol. C1, No. 2, p 175-212, 1983. 17 Tab, 103 Ref.

Descriptors: *Water quality, *Public health, *Carcinogens, *Reviews, Drinking water, Radionuclides, Organic compounds, Inorganic compounds, Industrial waste, Agricultural practices, Pesticides, Water pollution sources.

Concern is currently high over contaminants of natural origin and those that are inadvertently added through man's lack of attention over the years to drinking water supplies. Materials of natural origin include asbestiform materials or asbestos particles, radioactive components (radionuclides), natural marine oil seepage which is a source of polycyclic aromatic hydrocarbons, and inorganic chemicals resulting from weathering of rocks, soil leaching or other processes. Another source of drinking water contaminants arises from agricultural practices. Some of this contamination occurs through direct dumping of these agricultural chemicals into waterways, some from municipal sewage effluents, and, in farming areas, by soil erosion and so-called agricultural runoff from heavy rains and flooded areas. Some contamination occurs from aerial drift and aerial spraying operations. Industrial pollution of water resources results from spills of chemicals or petroleum, emission of chemicals into the atmosphere such as vinyl chloride, and direct discharge of improperly treated wastes. The search for alternative energy sources has also resulted in some contamination. Geothermal technologies might place radionuclides as pollutants into the water. Use of fossil fuel, and in particular the advanced coal combustion technologies and extraction processes are expected to yield some problems. The effect of water processing or treatment on contamination is discussed. The frequency and geographic variations in the distribution of contaminants is considered and information is provided on the identification and classification of carcinogenic contaminants in types of water including drinking water. Some data on risk assessment is provided. (Baker-IVI)
W84-02823

APPLICATION OF A TIME-DEPENDENT DISPERSION MODEL FOR DISPERSION PREDICTION IN NATURAL STREAMS,
Hong Kong Univ. Dept. of Civil Engineering.
P. H. Lui, and A. W. Jayawardena.
Hydrological Sciences Journal, Vol. 28, No. 4, p 475-483, December, 1983. 2 Fig, 5 Tab, 12 Ref.

Descriptors: *Dispersion, *Mathematical models, Tracers, Fickian models, Langrangian correlation, Hong Kong, Tung Chung stream, Lam Tsuen River, Yuen Long Channel, Indus River.

A time-dependent dispersion model based on Lagrangian correlation and calibrated using laboratory data is applied to predict dispersion in four narrow streams in Hong Kong, the Tung Chung Stream, Lam Tsuen River, Yuen Long Channel and Indus river. Two types of tracers were used, sodium chloride in the Tung Chung Stream and Lam Tsuen River, and sulforhodamine B in the Indus River and Yuen Long Channel. For early stages of dispersion of modified Fickian model was used to predict the values of dispersion coefficient. For large times a value time of 10 must be estimated before predictions can be made, and in this study it was estimated by trial and error. Satisfactory predictions have been obtained for the test reaches considered. (Murphy-IVI)
W84-02826

A PROPOSED UPSTREAM WEIGHT NUMERICAL METHOD FOR SIMULATING POLLUTANT TRANSPORT IN GROUNDWATER,
Shandong Univ., Jinan (China). Dept. of Mathematics.
N.-Z. Sun, and W. W.-G. Yeh.
Water Resources Research, Vol. 19, No. 6, p 1489-1500, December, 1983. 16 Fig, 2 Tab, 26 Ref, 1 Append.

Descriptors: *Groundwater pollution, *Path of pollutants, Mathematical models, Convection, Dispersion.

Based upon the concept of upstream weighting and multiple cell balance, a new numerical method was developed for simulating the two-dimensional transport process in groundwater. General triangular elements are used, and the center of each element is taken as an invented node. The discretized system of the solute transport equations is derived from the integral form that expresses the balance of mass in each element. An upstream weight that depends on the local Peclet number is directly added to the basis functions. When convective transport dominates the dispersive transport, this technique can eliminate the oscillation of solutions efficiently, with only a nominal increase of computation effort over that of the general linear triangular Galerkin finite element method. The accuracy of the proposed numerical model is tested against two classical problems for which analytical solutions exist. The agreement is nearly exact. The instabilities of numerical solutions occur not only in the simulation of convective dominated flows but also in the simulation of a practical groundwater pollution process. The adaptive upstream weights are successful for both cases. (Moore-IVI)
W84-02852

POLLUTION ROUTING IN STREAMS,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. D. Koussis, M. A. Saenz, and I. G. Tollis.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1636-1651, December, 1983. 2 Fig, 6 Tab, 18 Ref, 2 Append.

Descriptors: *Path of pollutants, *Dispersion, Mathematical models, Simulation, Stream pollution, Storage routing, Water quality.

A method for the numerical simulation of longitudinal dispersion of pollutants in streams is developed and tested. It is based on the one-dimensional, linear advection-dispersion equation and employs the concept of pseudo-viscosity to model the physical dispersion process. The numerical scheme is formally identical to a storage routing type scheme, and can provide the basis for an efficient computation of water quantity and water quality. The mathematical properties of this scheme are attractive; it is explicit, second-order-in-space accurate, and stable when used to model physical dispersion phenomena. The validity and reliability of the computations are investigated in three examples. These include an analytical test case, a laboratory test case, and a field test case, and deal with response prediction and parameter identification calculations. The method is capable of simulating the dispersion process reliably and with good accuracy. (Moore-IVI)
W84-02877

UNIFIED THEORY FOR FLOOD AND POLLUTION ROUTING,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. D. Koussis.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1652-1664, December, 1983. 1 Tab, 12 Ref, 2 Append.

Descriptors: *Flood routing, *Path of pollutants, Mathematical models, Dispersion, Diffusion, Water quality, Flood waves, Concentration waves.

Environmental concerns have placed increased emphasis on the simultaneous consideration of quantity and quality aspects of water resources problems. Flood and pollution routing can be accomplished by the same numerical scheme, derived from the discretization of the purely advective transport equation through exploitation of the scheme's numerical dispersion properties to model the physical dispersion/diffusion behavior of the flow system. The one dimensional advection-diffusion/dispersion equation (A/D equation) is the standard transport model for many water quality computations. The same type of equation describes approximately, but with sufficient accuracy for most practical cases, the movement of flood waves in open channels. The linear diffusion wave model is equivalent to storage routing models with which it shares an extremely efficient computational structure that makes it an attractive engineering tool. The diffusion/dispersion routing schemes can be used to compute efficiently the propagation of flood waves and conservative constituent concentration waves in natural and artificial channels. (Moore-IVI)
W84-02878

ATTENUATION OF GROUND-WATER CONTAMINANT PULSES,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. J. Valocchi, and P. V. Roberts.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1665-1682, December, 1983. 13 Fig, 2 Tab, 21 Ref, 3 Append.

Descriptors: *Groundwater pollution, *Dispersion, *Path of pollutants, Wastewater injection, Organic compounds, Mathematical equations, Alluvial aquifers, Palo Alto Baylands.

Analytical solutions to the one-dimensional advection-dispersion equation are presented for several cases where the source concentration is either input continuously at a periodically fluctuating level or input as a single pulse of finite duration. The solute of interest can undergo linear equilibrium adsorption. Both semi-infinite and infinite flow domains are considered. The solutions are utilized to quantify the degree to which the traveling contaminant pulses are attenuated (damped) as they migrate through an aquifer. The degree of damping is shown to be related to two dimensionless parameters and this relationship is conveniently presented in graphical form. The analytical results compare favorably with the behavior of trace organic contaminant pulses observed during injection of advanced-treated wastewater into a shallow, alluvial aquifer in the Palo Alto Baylands. (Author's abstract)
W84-02879

SIDE DISCHARGES INTO OPEN CHANNELS: MATHEMATICAL MODEL,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich 80.
For primary bibliographic entry see Field 8B.
W84-02880

SOURCES OF THE NITRATE IN PHREATIC GROUNDWATER IN THE WESTERN KALAHARI,
National Physical Research Lab., Pretoria (South Africa). Natural Isotopes Div.
T. H. E. Heaton.
Journal of Hydrology, Vol. 67, No. 1-4, p 249-259, 1984. 3 Fig, 1 Tab, 28 Ref.

Descriptors: *Nitrates, *Groundwater, Groundwater pollution, Agricultural wastes, Denitrification, Leaching, Deserts.

Elevated levels of nitrate occur in phreatic groundwater in the western Kalahari, Namibia. Nitrate in water containing 0.4-3.1 meq NO3/l, of widespread occurrence, has delta to the 15th power N values in the range +4.9 to +8.0%, suggesting natural derivation from the soil. The sporadic occurrence of very high levels of nitrate (>4 meq NO3/l), which has delta to the 15th power N

between +9.3 to +18.7%, reflects pollution derived from animal waste. It is important to consider the possible isotopic effects of denitrification, and to determine the significance of leaching in the nitrogen budget of the Kalahari soil. (Murphy-IVI)
W84-02896

TREND OF THE NITRATE AND AMMONIUM CONTENT OF PRECIPITATION WATER IN HUNGARY FOR THE LAST 80 YEARS,
Institute for Atmospheric Physics, Budapest (Hungary).
L. Horvath.
Tellus, Vol. 35B, No. 5, p 304-308, November, 1983. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Nitrates, *Ammonium, *Precipitation, Hungary, Seasonal variation.

The seasonal variation of ammonium and nitrate concentrations in precipitation water in Hungary has changed markedly from the 1900s. Recently, characteristic spring maxima can be observed. These differences in the annual variations are not a consequency of the annual variation of the precipitation amount. In particular, the high ammonium concentrations in January and December, 1902, were accompanied by nearly the same monthly precipitation amounts as in 1979/81. One of the possible reasons for the differences in the annual variation of nitrate concentration may be the effect of increased human activity since the beginning of this century. The influence of increased anthropogenic emission in the annual variation of ammonium concentration cannot be excluded from consideration. (Baker-IVI)
W84-02915

WATER QUALITY AND THE DISCHARGE OF COOLING WATER INTO RIVERS, LAKES AND COASTAL WATERS,
Ente Nazionale per l'Energia Elettrica, Rome (Italy).
R. Gasparini.
Water Science Technology, Vol. 15, p 15-30, 1983. 31 Ref.

Descriptors: *Water quality, *Cooling water, *Discharge measurement, *Rivers, *Lakes, *Coastal waters, Ecological effects, Environmental effects, Reviews, Water pollution effects.

This paper resumes some of the main findings and conclusions of a study group on cooling water problems set up by UNIPEDE. The paper represents only the personal point of view of the author, in particular as chairman of the above mentioned group. The basic aim of the work was the study of the effects of the discharge of cooling water in the receiving water bodies (rivers, lakes and coastal waters). This type of assessment permits a more balanced and pragmatic approach to aspects such as thermal pollution, entrainment, impingement and pollution by antifouling agents. The first part of the paper deals with the problem of damage to organisms entering a cooling system. An important factor in assessing the meaning of such aspect is the growing evidence that there is no reduction in fish population of the receiving water body associated with the operation of modern power plants despite the catch in the once through-cooling systems due to entrainment and impingement, that can be minimized, but not avoided. The second part deals with the different methods of fouling prevention in power plants, with their possible environmental effects in the receiving water bodies. The third part is a comprehensible review of the results of aquatic impact studies at power plants, that is the results of many experimental investigations carried out in the field to evaluate the effects of the operation of once through cooling systems sited on rivers, lakes, or coastal waters. (Author's abstract)
W84-02934

DECOMPOSITION AND TRANSPORT OF MONOCHLORAMINE IN FRESH WATER,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
Y-S. Lin, B. R. Kim, T. L. Bell, and R. J. Ruane.
Water Science and Technology, Vol. 15, p 215-226, 1983. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Decomposition, *Transport, *Monochloramine, *Fresh water, Aquatic life, First-order kinetics, Model studies, Chlorination, Chlorine residuals, Power plants.

Chlorinated effluents from cooling water condensers and wastewater treatment plants enter receiving streams and can affect aquatic organisms. The kinetics for dissipation of chlorine residuals (primarily monochloramine) in water under different light conditions (dark, sunlight, and UV light), by conducting a series of closed batch studies, was found to be first-order with respect to monochloramine concentration. This kinetic information was then incorporated into a two-dimensional transport model to describe concentration profiles in a river by considering the decay reaction, mixing, and dispersion, and by approximating the river as a straight rectangular channel. With chlorine residual persistence, chlorination at night could have more impact on aquatic life than during the day. (Murphy-IVI)
W84-02944

ANALYSIS OF EFFLUENTS AND RECEIVING WATERS ARISING FROM THE COAL FIRED KASIMPUR THERMAL POWER PLANT,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, A. A. Nomani, and M. A. Khan.
Water Science and Technology, Vol. 15, p 227-236, 1983. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Effluents,* Receiving waters, *Coal fired Thermal powerplant, *Kasimpur, Thermal powerplant, Ecological effects, Environmental effects, Metals, Cooling water, Chemical properties, Thermal pollution.

The waters of the upper Ganga canal, discharged cooling water and the machine washings of 530 MW Kasimpur coal fired thermal power plant were analysed for physico-chemical properties. The cooling effluent and washing downstream was richer in metal contents than upstream of the canal. The effects of influent and effluent water on the physico-chemical properties of soil, germination of seeds and growth pattern of the plants was insignificant. (Murphy-IVI)
W84-02945

ESTIMATED POLLUTION LOADINGS FROM NORWEGIAN FISH FARMS. II. INVESTIGATIONS 1980-1981,
Direktoratet for Jakt, Viltstell og Ferskvannsfiske, Aas (Norway).
A. Bergheim, H. Hustveit, A. Kittelsen, and A. R. Selmer-Olsen.
Aquaculture, Vol. 36, No. 1/2, p 157-168, January, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Aquaculture, *Water pollution sources, *Fish farming, Dissolved oxygen, Nitrogen, Nitrates, Phosphorus, Phosphates, Sodium, Potassium, Magnesium, Norway.

Pollution studies were carried out at a freshwater fish farm in 1980-81. The farm is situated near a fjord in the western part of Norway. Farming activity here is large, with both hatchery and many rearing units for salmonid fingerlings and brood fish. Two different investigations were carried out at the farm: a pollution loading registration during 24 hr in two farm sections, and a continuous registration of the water quality in the inlet/outlet of 37 fish tanks during 8 months. Several parameters were influenced markedly by the farming activity. Concentrations of total N increased by about 1000 micrograms/liter between the inlet and outlet. Increased phosphorus concentrations were also noted. Loading levels per unit of fish biomass were related to fish size. Loading/fish biomass decreased clearly with increasing fish weight. (Baker-IVI)
W84-02948

5C. Effects Of Pollution

CAROTENOID ENHANCEMENT AND ITS ROLE IN MAINTAINING BLUE-GREEN ALGAL (MICROCYSTIS AERUGINOSA) SURFACE BLOOMS,
North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
H. W. Paerl, J. Tucker, and P. T. Bland.
Limnology and Oceanography, Vol. 28, No. 5, p 847-857, September, 1983. 6 Fig, 31 Ref. OWRT grant BNC-027 and NSF grant DEB 8104689.

Descriptors: *Eutrophication, *Microcystis, *Carotenoids, *Chlorophyll a, Cyanophyta, Photosynthesis, Ultraviolet radiation, Near-ultraviolet radiation, Photosynthetically active radiation.

Some blue-green algal genera can, through buoyancy alteration, accumulate in surface waters. An obvious advantage of such an accumulation is the ability to reside in a radiant energy-rich section of the water column, particularly in eutrophic or highly colored waters where photosynthetically active radiation is rapidly extinguished with depth. Despite the clear advantage of dominating surface waters, extensive residence in these waters also exposes algae to potentially harmful near-ultraviolet radiation. Photosynthetic pigment alteration by Microcystis aeruginosa in surface blooms was related to persistence and dominance by this blue-green alga. The progression of summer blooms coincided with rising carotenoid : chlorophyll a ratios. When analyzed by high performance liquid chromatography (HPLC), carotenoids exhibited strong in vitro absorbance in the UV and near-UV regions. Increased cellular carotenoid content was accompanied by increased surface photosynthesis as well as increased photosynthetic efficiencies in surface Microcystis populations. Radiant energy is most effectively utilized as a source of photoreducing power in the presence of elevated cellular carotenoid : chlorophyll a ratios of surface populations. Enhanced cellular carotenoid synthesis increases light utilization in the low and middle regions of the photosynthetically active radiation (PAR) spectrum and provides protection from UV damage. This has a positive effect on photosynthetic CO2 fixation and bloom persistence in surface waters. (Moore-IVI)
W84-02484

NUTRIENT DYNAMICS IN SMALL MESOTROPHIC FENS SURROUNDED BY CULTIVATED LAND; I. PRODUCTIVITY AND NUTRIENT UPTAKE BY THE VEGETATION IN RELATION TO THE FLOW OF EUTROPHICATED GROUND WATER,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
J. T. A. Verhoeven, S. van Beek, M. Dekker, and W. Storm.
Oecologia, Vol. 60, No. 1, p 25-33, 1983. 9 Fig, 3 Tab, 20 Ref.

Descriptors: *Fens, *Eutrophication, *Productivity, *Nutrients, Groundwater pollution, Water pollution effects, Groundwater movement, Nitrogen, Phosphorus, Potassium, Ammonia, Peat, Mineralization, Wetlands, Grasslands, Polders, Netherlands.

In a typical Dutch polder landscape the effects of nutrient transport from cultivated grassland to mesotrophic fen communities were studied. In a comparative approach, biomass production and nutrient (N, P and K) uptake were determined monthly in four fens and a hayfield differing in productivity and species composition. The interstitial ground water was sampled every two weeks for determinations of inorganic nutrient concentrations. The differences in productivity between the fens were clearly reflected in the amount of N, P and K taken up in the above-ground vegetation. N and P proved to be limiting plant growth in the fens, whereas K was the main limiting factor in the hayfield. The groundwater welling up from the sandy bottom into the fens proved to be rich in ammonia (3-5 ppm). There are strong indications that this continual seepage leads to a considerable

input of N into the fens but not to a higher productivity, as the ammonia is absorbed by the lowermost peat layers covering the sand. At this moment, the differences in productivity between the fens must be caused by differences in the rates of mineralization of the superficial peat layer. The degree of fixation of the floating vegetation mat, determining whether or not low water levels lead to an aerated soil top layer, is important in this respect. Within a period of decades, however, the continuous inflow of ammonia may eventually cause an increase in the productivity and a change in the species composition of the fens. (Author's abstract)
W84-02496

NUTRIENT GAIN FROM WET AND DRY ATMOSPHERIC DEPOSITION AND RAINFALL ACIDITY IN SOUTHERN CALIFORNIA CHAPARRAL,
San Diego Univ., CA. Dept. of Botany.
B. A. Ellis, J. R. Verfaillie, and J. Kummerow.
Oecologia, Vol. 60, No. 1, p 118-121, 1983. 3 Tab, 26 Ref. NSF grant DEB-8025977-0.

Descriptors: *Nutrients, *Precipitation, *Acid rain, *Chaparral, *California, Atmospheric deposition, Nitrogen, Calcium, Magnesium, Air pollution.

Ionic concentration and annual deposition of NO3(-)-N, NH4(+)-N, Ca(2+), and Mg(2+) from bulk precipitation and dry atmospheric deposition were studied for one year in southern California. Data were collected from an inland chaparral site at 1,300 m elevation, 75 km from the coast. The annual depositions of NO3(-)-N, and NH4(+)-N amounted to 96.3 and 56.0 mg/sq m ground area/yr, respectively. The corresponding values for calcium and magnesium ions were 207.4 and 57.4 mg/sq m/yr. The average pH of rainwater was 3.74 (range 3.37 to 4.75), thus documenting acid rain for an inland site in California, distant from urban sources of air contamination. An estimate of nitrogen gains and losses indicated that the time between recurrent chaparral fires should be about 60 years in order to maintain a balanced nitrogen budget. (Author's abstract)
W84-02497

LEAF LITTER DECOMPOSITION IN A RESERVOIR AFFECTED BY ACID MINE DRAINAGE,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. Carpenter, W. E. Odum, and A. Mills.
Oikos, Vol. 41, No. 2, p 165-172, 1983. 2 Fig, 4 Tab, 28 Ref.

Descriptors: *Acid mine drainage, *Decomposition, *Litter, *Reservoirs, Water pollution effects, Leaves, Heterotrophs, Detritus, Microorganisms, Bacteria.

The effects of acid mine drainage on the decomposition of vascular plant material in a reservoir were compared at three sites: (1) a control site with no acid mine drainage (average pH = 6.3), (2) an experimental site with dilute acid mine drainage (average pH = 5.7) and (3) an experimental site near the acid mine drainage source (average pH = 3.7). The decomposition rate (loss of ash free dry weight from litter bags) of leaves from three types of trees and a rush differed significantly between leaf species and between sites. For all leaf species, the decay rate coefficients (k) for the control site were at least twice those for the most severely affected experimental site. Heterotrophic activity, measured with C-14 glucose, was depressed at both experimental sites as compared to the control site. Numbers of bacteria were about 10 to the 10th cells per gram dry detritus, and did not differ significantly between control and experimental sites. It was concluded that: (1) both microbial activity and the process of leaf decomposition were inhibited in a region close to the source of contamination although (2) the degree of inhibition decreased as the acid mine drainage was diluted within the reservoir. (Author's abstract)
W84-02498

DISCOVERING THE CAUSES, CONSEQUENCES, AND IMPLICATIONS OF ACID RAIN AND ATMOSPHERIC DEPOSITION,
North Carolina State Univ. at Raleigh. School of Forest Resources.
E. B. Cowling.
Tappi Journal, Vol. 66, No. 9, p 43-46, September, 1983. 2 Fig, 14 Ref.

Descriptors: *Acid rain, *Forestry, *Environmental effects, Lakes, Streams, Fish kills, Sulfuric acid, Nitric acid, Ozone, Distribution, Soil contamination, Plants, Nutrients, Water quality.

Areas receiving high acidic precipitation, average annual pH between 4.1 and 4.6 include many regions in which surface waters and aquatic life are sensitive to or are presently being affected by acid precipitation. The release of pollutants in meltwater during warm periods in winter or in early spring can cause dramatic consequences of acid input into aquatic ecosystems. In certain industrial regions of the world substantial damage to forests and crops is caused by dry deposition of toxic gases. Ozone, sulfur dioxide, oxides of nitrogen, fluoride, and hydrogen chloride are some of the worst offenders. The consequences of acid inputs to soils vary greatly, depending on the rates and recent history of atmospheric acid inputs, the character of the vegetation, natural rates of acid formation in the soil, and the physical/chemical properies of the soil. Acid precipitation increases the solubility and mobility of many cations in the soil. This increases the concentration of toxic metal cations, including potassium, aluminum, manganese, and zinc in the soil solution. It also increases the leaching of nutrient cations, including calcium and magnesium. These toxic and nutrient ions are transferred from soils into surface waters and groundwaters. Certain aspects of the acid precipitation problem are still not well understood and additional work is needed to develop possible solutions to the question. (Baker-IVI)
W84-02521

ACUTE TOXICITY AND BIOACCUMULATION OF LINDANE IN GUDGEON, GOBIO GOBIO (L.),
Liege Univ. (Belgium). Zoology Inst.
C. Marcelle, and J. P. Thome.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 4, p 453-458, October, 1983. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Lindane, *Fish, *Toxicity, *Bioaccumulation, *Gudgeon, Insecticides, Organochlorine pesticides, Organic compounds.

Acute toxicity tests were conducted with lindane on gudgeons to determine a LC50 (96 hr). Lindane contents in muscles, brain and liver were measured and factors of bioaccumulation of lindane were calculated. Lindane contents as measured in these tissues increased with lindane concentrations in water. This increase was relatively moderate until the 28.5 ppb level of lindane concentration in water was reached. Beyond this concentration, lindane concentration in liver and brain rose more sharply. Lindane concentration of 28.5 ppb in water was a threshold beyond which the accumulation of lindane in tissues and organs induced an increase in mortality. Bioaccumulation dramatically decreased between 0.22 and 28.5 ppb of lindane in water but increased beyond this threshold concentration. A very highly significant linear correlation was found between both variables in the case of brain and a very highly signficant logarithmic correlation in the cases of liver and muscles. The decimal lindane concentrations in brain exponentially increased with lindane concentrations in water. The brain appeared to accumulate lindane at a slower rate than liver and muscles when the lindane concentrations in water were low. This does not hold at concentrations above 30 ppb. A new method for extracting lindane from water is described. (Baker-IVI)
W84-02533

EFFECTS OF WATER HARDNESS, WATER TEMPERATURE, AND SIZE OF THE TEST ORGANISM ON THE SUSCEPTIBILITY OF THE FRESHWATER SHRIMP, GAMMARUS PULEX (L.), TO TOXICANTS,
Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre.
R. R. Stephenson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 4, p 459-466, October, 1983. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Shrimp, *Water pollution effects, *Toxicity, *Water temperature, *Water hardness, Size, Hardness, Chemical properties, Phenol, Copper, Lindane, Diethylhexyl phthalate.

The effects of water hardness, water temperature, size of test organism and duration of exposure on the acute toxicity of four substances to Gammarus pulex, the freshwater shrimp were investigated. The four test substances were phenol, copper (as cupric chloride), gamma-hexachlorocyclohexane (lindane), and di-ethylhexyl phthalate (DEHP). The influence of the three variables, water hardness, water temperature and size of organism, on the acute lethal toxicity of the four test materials to G. pulex was generally small. Only water hardness had statistically significant effects of LC50 values, and then only for copper and gamma-HCH when exposure periods were 48 hr or greater. Copper was some 4 to 6 times more toxic in soft water than in hard, whereas gamma-HCH was 1.5 to 2.5 times more toxic in hard water than in soft. Guidelines for acute lethality tests with G. pulex should recommend that tests be carried out in hard water, at 15 degrees C, with large specimens and that the exposure period should be 96 hr without a period of post-exposure observation. Large specimens are more easily observed and handled. (Baker-IVI)
W84-02534

EFFECTS OF ENVIRONMENTAL PH AND TEMPERATURE ON EMBRYONIC SURVIVAL CAPACITY AND METABOLIC RATES IN THE SMALLMOUTH SALAMANDER, AMBYSTOMA TEXANUM,
Tampa Univ., FL. Dept. of Biology.
F. Punzo.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 4, p 467-473, October, 1983. 2 Tab, 17 Ref.

Descriptors: *Salamanders, *Temperature effects, *Hydrogen ion concentration, Acidity, Water pollution effects, Water temperature, Hatching, Embryonic development, Oxygen consumption, Larvae.

Eggs and larvae of Ambystoma texanum were used in the study. Embryonic development was unsuccessful at 5 C and 30 C regardless of environmental pH. The optimum hatching success at all pH regimes occurred at 15 C for this species. Moderate hatching success (50 to 89%) was observed between 10 and 20 C within a pH range of 6 to 10. Optimal conditions included a pH range of 6 to 8. The most pronounced detrimental effects of pH on embryonic survival capacity were found at pH 4 to 5 and pH 11 over the temperature range of 10 to 25 C. The highest rate of oxygen consumption was at pH 6.6 for all developmental stages. Significant differences were found between oxygen consumption rates of fertilized eggs observed at pH 4 and 5 for the dorsal lip, late gastrula and neural plate developmental stages. Mortality in this species can be expected to increase markedly when the pH of pond water falls below 6.0 or exceeds 10.0. (Baker-IVI)
W84-02535

EFFECT OF THE AQUATIC HERBICIDE ENDOTHAL ON THE CRITICAL THERMAL MAXIMUM OF RED SHINER, NOTROPIS LUTRENSIS,
North Texas State Univ., Denton. Dept. of Biological Sciences.
J. C. C. Takle, T. L. Beitinger, and K. L. Dickson.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 5, p 512-517, November, 1983. 3 Tab, 27 Ref.

Descriptors: *Herbicides, *Weed control, *Fish, *Endothal, Toxicity, Shiners, Pesticides, Water temperature.

Red shiners were exposed to endothal for 48 hr. Endothol, as Aquathol-K did not significantly alter the critical thermal maximum (CTM) of Notropis lutrensis at the concentrations of 1 mg/L and 30 mg/L acid equivalence. These are the concentrations recommended for weed control. The mean CTM of 36.0 C for red shiner from these studies is slightly lower than reported values of 38.99, 37.8 and 38.0 C. Since endothal is usually degraded within one to five days by microbial activity, it has low persistence in aquatic environments. Even at concentrations 6 times the maximum recommended for aquatic use, endothal did not reduce the ability of red shiners to resist high temperatures. (Baker-IVI)
W84-02536

EFFECTS OF TEMPERATURE ON BEHAVIOR, GROWTH, DEVELOPMENT AND SURVIVAL IN YOUNG MILKFISH, CHANOS CHANOS (FORSKAL),
Southeast Asian Fisheries Development Center, Iloilo (Philippines). Aquaculture Dept.
A. C. Villaluz, and A. Unggui.
Aquaculture, Vol. 35, No. 4, p 321-330, December, 1983. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Milkfish, *Water temperature, *Growth, *Fish behavior, Feeding, Dissolved oxygen, Development.

Effects of three temperature treatments on activity, feeding, growth, development and survival of young milkfish (Chanos chanos) were investigated. Low temperature (<22.6 C) and hypoxial condition (<1 ppm O2) decreased activity, responsiveness and food intake; high temperature (up to 33 C) had the opposite effect. Growth and development were fastest in fish maintained in high temperature ($\bar{x}$ = 29.5 C). Fish in low temperature ($\bar{x}$ = 20.7 C) had the least growth and were inhibited from developing into juveniles during the 3-month period. Highest survival ($\bar{x}$ = 99.7%) was obtained in high temperature but was not significantly different ($P>0.05$) from ambient temperature ($\bar{x}$ = 97.7%). (Author's abstract)
W84-02540

POPULATION DYNAMICS OF CAULOBACTERS IN A MESOTROPHIC IRRIGATION POND,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W84-02548

THE GRAM-STAIN CHARACTERISTICS OF THE BACTERIAL COMMUNITY AS A FUNCTION OF THE DYNAMICS OF ORGANIC DEBRIS IN A MESOTROPHIC IRRIGATION POND,
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W84-02549

PREDICTIVE CAPABILITY OF U.S. OECD PHOSPHORUS LOADING - EUTROPHICATION RESPONSE MODELS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
W. Rast, R. A. Jones, and G. F. Lee.
Journal of the Water Pollution Control Federation, Vol. 55, No. 7, p 990-1003, July, 1983. 4 Fig, 3 Tab, 57 Ref.

Descriptors: *Eutrophication, *Model studies, *Phosphorus, Nutrients, Water quality control, Water management, Mathematical models, Algae, Aquatic plants.

Two basic types of mathematical models have been developed for eutrophication modeling: statistical and dynamic models. Dynamic models consist basically of a series of interrelated differential equations which attempt to describe the biological, chemical, and physical reactions and interactions governing aquatic plant growth. A statistical eutrophication model is basically a statistical regression that quantifies a basic cause-and-effect relationship and does not attempt to account for or characterize every component involved in the eutrophication process. The predictive capability of the US Organization for Economic Cooperation and Development (OECD) eutrophication modeling approach regressions was examined by comparing the predicted and measured responses of water bodies subjected to substantial changes in their phosphorus loads. Certain conditions should be met before this model is applied to any water body. A principal prerequisite is that maximum summer algal biomass in the water body be limited by phosphorus. Another is that aquatic plant growth be manifested primarily as planktonic algae, rather than as attached algae or aquatic macrophytes. The water bodies must behave like completely mixed reactors; that they have constant volumes; and that P sedimentation is proportional to in-lake concentration. Implications of phosphorus loading eutrophication models for eutrophication management in water bodies are discussed. (Baker-IVI)
W84-02562

SURVIVAL INCIDENCE OF ANTIBIOTIC-RESISTANT COLIFORMS IN A LAGOON SYSTEM,
Biospherics, Inc., Rockville, MD.
A. J. Kish, and J. R. Lampky.
Journal of the Water Pollution Control Federation, Vol. 55, No. 5, p 506-512, May, 1983. 1 Fig, 7 Tab, 26 Ref.

Descriptors: *Coliforms, *Wastewater lagoons, Antibiotic resistance, Bacteria, Public health, Human pathology, Wastewater treatment, Freezing, Eutrophication.

The survival incidence of coliform bacteria resistant to five different antibiotics in a lagoon system that freezes during the winter was investigated. Some of the resistant species were identified. The percentage of resistant coliforms in the lagoon discharge and receiving creek were quantified and tests were performed for transmissable drug resistance in the discharged coliforms. The average number of total coliforms in all ponds rose during each of the last four sampling dates, but the percentage that were drug-resistant continued to decrease. This rise in total coliforms was perhaps due to increases in lagoon water depth, and therefore, decreases in ultraviolet light penetration, warming of the water, breakage of the ice pack and aeration, and the subsequent unicellular algal bloom witnessed in the early spring. The reason for the continued percentage decrease of drug-resistant coliforms is not clear. It is not clear why discharged coliforms resistant to cephalothin and ampicillin showed a large increase in incidence compared with the in-lagoon corresponding percentages for roughly the same time period. When resistance to one antibiotic is transferred, resistance to several other antibiotics is also conferred, though this was not tested, specifically. Even though over half of the tested strains could transfer tetracycline resistance to sensitive strains in the laboratory, probably a very low percentage could actually perform this transfer in the wild because turbulent conditions would easily break apart conjugation bridges. (Baker-IVI)
W84-02568

BIOASSAY EVALUATION OF DIVERSITY AND COMMUNITY COMPARISON INDEXES,
Alabama Univ. in Birmingham. School of Public Health.
J. L. Perkins.
Journal of the Water Pollution Control Federation, Vol. 55, No. 5, p 522-530, May, 1983. 4 Fig, 3 Tab, 22 Ref.

Descriptors: *Aquatic life, *Bioassay, Dissolved oxygen, Copper, Acidity, Water temperature, Specific conductivity, Benthic environment, Ecosystems.

The following community comparison or similarity indexes and diversity indexes were evaluated: Gleason's, Margalef's, Menhinik's, Simpson's, McIntosh's, Brillouin's, Shannon's, Shannon's approximate, Pielou's evenness, Margalef's redundancy, equitability, Jaccard's coefficient, Sokal and Michener's, Sorensen's coefficient, percentage similarity, coefficient of biosimilarity, distance, Bray-Curtis, Morisita's index, and Horn's index. Evaluation was made using a controlled community bioassay approach. If communities are constructed in which all environmental variables are equivalent, then impact caused by some added pollutant can be assessed and compared to a control community. Response of a community of benthic macroinvertebrates to geometric increases in copper concentration was measured. Shannon's index cannot be used alone. Community comparison indexes can be used to indicate even slight impact with come confidence. Shannon's index may give an indication of no impact or enrichment, when in fact there is some impact. The community comparison indexes do hold the possibility that as a group they can accurately address the issue of magnitude of impact on the community. Because all the indexes used ranged from zero to one, absolute changes in community similarity may be such that they can be grouped into high, medium, and low impact categories. (Baker-IVI)
W84-02570

EFFECTS OF AMMONIA AND CHLORINE ON FISH IN STREAMS RECEIVING SECONDARY DISCHARGES,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
M. H. Paller, W. M. Lewis, R. C. Heidinger, and L. J. Wawronowicz.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1087-1097, August, 1983. 4 Fig, 7 Tab, 13 Ref.

Descriptors: *Fish populations, *Water pollution effects, *Chlorination, Wastewater treatment facilities, Secondary wastewater treatment, Chlorine, Ammonia, Turbidity, Illinois, Copper Slough, Kaskaskia Ditch, Saline Branch, Stream pollution.

Three streams receiving chlorinated secondary wastewater were monitored for about 1 year's time. Chlorination was then terminated but monitoring continued with particular reference given to changes that might have occurred in the fish communities when only ammonia was present without the chlorine. Samples were taken above and below the wastewater outfalls, on Copper Slough (receiving secondary wastewater of wholly domestic origin from the Champaign-Urbana Southwest Sewage Treatment Plant), Kaskaskia Ditch (receiving secondary wastewater from Copper Slough, its tributary), and Saline Branch, (receiving secondary wastewater from the Champaign-Urbana Northeast Plant, 81% domestic and 19% soybean and dairy processing waste). Total residual chlorine concentrations were generally highest at the first station below the wastewater outfall, and declined progressively at stations located further downstream. Total ammonia-N concentrations below the outfalls were much higher than total ammonia-N concentrations above the outfalls in all streams. Ammonia-N concentrations were fairly similar before and after chlorination was discontinued in Copper Slough and Kaskaskia Ditch. In contrast, ammonia-N concentrations in Saline Branch were higher after chlorination was discontinued, largely due to operational problems associated with the renovation of the sewage treatment plant. Turbidity was either greater above the outfall than below or quantitatively similar in both areas. However, wastewater associated turbidity below the outfall was qualitatively different from ambient turbidity above the outfall, as it consisted largely of sludge like materials, rather than silt or algae. The fish community in Copper Slough improved dramatically after chlorination was discontinued. Similar findings are reported for Kaskaskia Ditch, but not for Saline Branch, indicating that residual chlorine was not the only limiting factor in the effluent from the Northeast Treatment Plant. (Baker-IVI)
W84-02576

EFFECT OF EFFLUENT DISINFECTION ON RISKS OF VIRAL DISEASE TRANSMISSION VIA RECREATIONAL WATER EXPOSURE,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1111-1116, August, 1983. 4 Tab, 34 Ref.

Descriptors: *Recreation, *Viruses, *Disinfection, *Effluents, *Disease transmission, Water treatment, Water quality control, Human diseases, Illinois, Water quality standards.

The assertion of minimal risk associated with the relaxation of fecal coliform standards and, implicitly, with wastewater disinfection is questioned. Evaluation of available data seems to show that the cessation of wastewater disinfection in Illinois may result in up to 2700 excess cases of viral disease per year because of recreational exposure. This risk, which on an absolute basis is not insignificant, when averaged over the entire state population is sufficiently low as to preclude facile detection. To develop a more precise estimate of the risk, one must give particular attention to obtaining data on viral decay, the specific numbers of recreational users at each stream site, and the probability that ingestion of an organism will result in disease. A general approach is outlined which should be suitable for analysis of specific stream locations, or the estimation of risk evaluation caused by recreationally contracted viral disease in other localities. (Baker-IVI)
W84-02579

A MARINE RECREATIONAL WATER QUALITY CRITERION CONSISTENT WITH INDICATOR CONCEPTS AND RISK ANALYSIS,
For primary bibliographic entry see Field 5A.
W84-02600

ANALYSIS OF 2,2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN GREAT LAKES FISH,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
P. O'Keefe, C. Meyer, D. Hilker, K. Aldous, and B. Jelus-Tyror.
Chemosphere, Vol. 12, No. 3, p 325-332, 1983. 2 Tab, 22 Ref.

Descriptors: *Fish, *Water pollution effects, *Trichlorophenols, TCDD, Phenols, Tetrachlorodibenzo-p-dioxin, Great Lakes, Lake Ontario, Lake Huron, Water pollution sources.

Fish samples were taken from Lake Ontario and Lake Huron and analyzed for content of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Concentrations ranging from 2 to 162 pg/g (ppt) and from 2.5 to 20 ppt were found in the two lakes, respectively. Fish from other of the Great Lakes generally had no detectable signals for TCDD although a few samples had concentrations less than 3 ppt. One of the sampled areas, Cayuga Creek, enters the Niagara River and is connected to a storm sewer in the vicinity of the Love Canal, Niagara Falls, a former waste disposal site which received a variety of chemical wastes, including trichlorophenol wastes. While there are no manufacturing facilities for trichlorophenols on the peripheries of Lake Erie, Lake Michigan, or Lake Superior, certain parts of these lakes are undoubtedly exposed to significant quantities of fly ash, an alternative source of TCDD. (Baker-IVI)
W84-02622

THE IMPACT ON THE ECOLOGY OF POLYCHLORINATED PHENOLS AND OTHER ORGANICS DUMPED AT THE BANK OF A SMALL MARINE INLET,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
J. Folke, J. Birklund, A. K. Sorensen, and U. Lund.
Chemosphere, Vol. 12, No. 9/10, p 1169-1181, 1983. 4 Fig, 2 Tab, 38 Ref.

Descriptors: *Water pollution effects, *Pentachlorophenol, *Tetrachlorophenol, *Waste dumps, Leachates, Organic compounds, Mussels, Sediments, Marine environment, Effluents, Marine animals, Holbaek Fjord, Denmark.

Municipal waste was dumped at the bank of a small marine inlet, the Holbaek Fjord (Denmark), during the period from 1953 to 1971 together with unknown amounts of chemical wastes. Leachate samples from the dump were shown to contain a number of organics, whereof pentachlorophenol (PCP) and 2,3,4,6-tetrachlorophenol (TeCP) constituted the greatest potential risk in relation to amounts and toxicity. PCP and TeCP were quantified in mussels (Mytilus edulis) stocked in growth cages, marine sediments, sea water, and in the secondary effluent of a nearby sewage treatment plant. The condition of the natural fauna was examined in terms of species composition, species density, and species diversity. The levels of PCP and TeCP were only slightly increased as compared to a reference area, and no acute toxic effects were detected. The present impact of the dump on the marine ecosystem based on the PCP burden is a factor of 1000 lower than the estimated effect level. It is recommended that the situation be monitored until it is evident that the leaching of organics from the dump has maximized and is declining. (Moore-IVI)
W84-02629

THE IDENTIFICATION AND EVALUATION OF BENTHIC MACROINVERTEBRATE ASSEMBLAGES IN AN INDUSTRIALISED ESTUARY-SOUTHAMPTON WATER, UK, USING A LONG-TERM, LOW-LEVEL SAMPLING STRATEGY,
Southern Water Authority, Otterbourne (England). Resources Planning Lab.
M. Houston, D. Lowthion, and P. G. Soulsby.
Marine Environmental Research, Vol. 10, No. 4, p 189-207, 1983. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Invertebrates, *Sampling, *Southampton Water, *England, *Estuarine environment, Water pollution effects, Benthos, Temporal distribution, Spatial distribution, Industrial wastewater, Species diversity.

Southampton Water is a shallow, linear body of water approximately 10 km long and 2 km wide. A narrow shipping channel is dredged to maintain a depth of 10 m below Chart Datum and is bordered by shallow water and some extensive intertidal mudflats. A long-term, low-intensity sampling strategy has been applied to the benthic infauna of Southampton Water to determine patterns of faunal distribution in relation to water quality influences. The estuary receives domestic and industrial discharges including a large oil refinery and associated petro-chemical industries. The faunal data from all the sites examined demonstrates a low species richness, low diversity and frequent numerical domination by a few species, suggesting the fauna is physically accommodated and provides a complex background against which to measure the effects of polluting effluents. The sites have been faunistically divided into three groups. Group I sites indicate an area of gross pollution. Group II sites are situated above and below the affected zone supporting a more diverse fauna. Group II and III sites both show a low species richness typical of a stressed, physically accommodated fauna. Spatial and temporal variations emphasize the need for a long-term approach to demonstrate the dominant faunal patterns in an area receiving a variety of discharges. The approach is economic in use of resources but compatible with the objectives of monitoring surveys. (Moore-IVI)
W84-02694

COMPARISONS OF TROPHIC STATE MEASUREMENTS,
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 2H.
W84-02709

COMPLEXATION OF COPPER IN THE EFFLUENT OF A SEWAGE TREATMENT PLANT AND AN ESTIMATE OF ITS INFLUENCE ON TOXICITY TO COHO SALMON,
Seattle Metro Water Quality Lab., WA.
J. A. Buckley.
Water Research, Vol. 17, No. 12, p 1929-1934, 1983. 2 Fig, 4 Tab, 30 Ref.

Descriptors: *Copper, *Effluents, *Toxicity, *Salmon, Water pollution effects, Copper compounds, Organic compounds, Wastewater treatment, Trace metals, Complexation.

Measurements by cupric ion electrode of the complexing capacity of the effluent from a sewage treatment plant (STPE) averaged 0.300 mg/l. Of the complexed Cu 67% was due to compounds of < or = 10,000 MW. Organic compounds removable by activated carbon composed 88% of the total organic carbon and were responsible for 87% of the complexation. Complexation of Cu(2+) by STPE diminishes the toxicity from total Cu to juvenile coho salmon; the LC50 was 0.164 mg/l for river water vs 0.286 mg/l for 40% STPE. The LC50 of Cu(2+) was approximately the same (0.017 vs 0.022 mg/l) in both matrices; this species thus appears to play a toxic role. The mean survival time in diluted STPE with added Cu was inversely proportional to the Cu(2+) concentration. (Author's abstract)
W84-02734

EVALUATION OF AN APPLICATION FACTOR FOR DETERMINING THE SAFE CONCENTRATION OF AGRICULTURAL AND INDUSTRIAL CHEMICALS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
S. R. Verma, I. P. Tonk, A. K. Gupta, and M. Saxena.
Water Research, Vol. 18, No. 1, p 111-115, 1984. 4 Tab, 32 Ref.

Descriptors: *Application factor, *Toxicity, *Fish, Pesticides, Phenols, Heavy metals, Detergents, Agricultural chemicals, Larvae, Water pollution effects, Water quality standards.

An Application Factor can be defined as a decimal fraction of TL50 or a toxic unit acceptable as a reasonable estimate of a safe concentration in nature. The Application Factor of a toxicant experimentally determined for one species of fish may be applicable to other fish species. The Application Factors for a number of chemicals used in industrial and agricultural operations were evaluated by determining 96 h LC50 and maximum allowable toxicant concentration (MATC) using larvae and early juveniles of Cirrhina mrigala. The chemicals used were thiotox, aldrin, chlordane, lindane, benzene hexachloride (organochlorine pesticides); malathion, metasystox, dichlorvos, thiometon, abate (organophosphate pesticides); carbofuran, sevin (carbamate pesticides); phenol, 2,4-dinitrophenol, pentachlorophenol (phenolic compounds); copper sulfate, cadmium chloride, zinc sulfate, mercuric chloride (heavy metals) and swascofix P14, swanic 6L, swascol 3L, swascol 4L (synthetic detergent). Application factors for these chemicals range between 0.036 and 0.079. The values of Application Factor for most of the chemicals remained within the limited range, in spite of a wide range in their MATC. The use of an Application Factor provides an alternative to the cumbersome life cycle toxicity test. It also paves the way for an easy determination of a safe concentration irrespective of the water characteristics and organism involved, by multiplying the larval LC50 by the Application Factor. (Moore-IVI)
W84-02742

BACTERIAL QUALITY OF TILE DRAINAGE WATER FROM MANURED AND FERTILIZED CROPLAND,
Department of Agriculture, Ottawa (Ontario).
N. K. Patni, R. Toxopeus, A. D. Tennant, and F. R. Hore.
Water Research, Vol. 18, No. 2, p 127-132, 1984. 6 Tab, 15 Ref.

Descriptors: *Drainage water, *Bacteria, *Tile drainage, *Manure, *Fertilizers, Coliforms, Strep-

tococci, Water pollution sources, Groundwater pollution, Precipitation, Soil texture, Ontario.

Bacterial contamination of tile drainage water in three manured and one non- manured cropped fields was studied over a 4-year period at a large, mixed farm near Ottawa, Ontario, Canada. Concentrations of total coliforms, fecal coliforms (FC), fecal streptococci (FS) and Standard Plate Counts at 20 and 35 C, in both the drainage water and the applied dairy cattle liquid manure varied over a wide range. Bacterial concentrations in long-term winter-stored manure were much lower than in relatively fresh manure. Concentrations of FC and FS in the drainage water from the manured fields were lower than concentrations in the applied manure by 3-5 orders of magnitude. Bacterial concentrations in drainage water from all fields had low geometric mean and median values for all parameters tested. Water quality was satisfactory most of the time for recreational use or for use as a raw water source for drinking water supplies. Factors such as precipitation appeared to have a greater influence on drainage water quality than manure application. Influence of soil type on bacterial concentrations in drainage water from the manured fields was not evident. However, a lower unit-area tile outflow in coarse-textured soil compared to fine-textured soil indicated a greater potential in the former for fecal bacteria reaching groundwater beneath the tile drains. (Author's abstract)
W84-02743

COMPARATIVE STUDIES ON ECOTOXICOLOGY OF SYNTHETIC DETERGENTS,
Industrial Toxicology Research Centre, Lucknow (India).
H. Lal, V. Misra, P. N. Viswanathan, and C. R. Krishna Murti.
Ecotoxicology and Environmental Safety, Vol. 7, No. 6, p 538-545, December, 1983. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Detergents, *Toxicity, Alkyl benzene sulfonate, Daphnia, Mosquitos, Tubifex, Snails, Tadpoles, Fish, Larvae, Behavior, Ecosystems.

To predict the comparative toxicological response of synthetic detergents on aquatic ecosystems, the effects of various concentrations of neutralized alkyl benzene sulfonate were studied. The median tolerance limit at 48 hr, 95% confidence limit, slope function, presumable harmless concentration, and rate of survival of different species of aquatic fauna such as water fleas (Daphnia magna), mosquito larvae (Culex pipiens), slug worms (Tubifex rivulorum), snails (Lymnaea vulgaris), tadpoles (Rana cyanophlyctis), and fish fingerlings (Cirrhina mrigala) were followed at 0, 24, 48, 72, and 96 hr. The median tolerance limit values at 48 hr. were 0.013, 0.049, 0.060, 0.080, and 0.022 ppm for water fleas, tadpoles, slug worms, snails, mosquito larvae, and fingerling, respectively. Daphnia is the most susceptible species to detergents whereas mosquito larvae are fairly resistant. At concentrations of 0.01-0.04 ppm the rate of survival of tadpoles was 100% but on increasing the concentration from 0.04 to 0.05 ppm there was a sudden change in the rate of survival. In fish fingerlings, there was a sudden change in the rate of survival between 0.01 and 0.02 ppm. Behavioral changes were also observed in exposed animals. There were no significant changes in the physical characteristics of the water such as dissolved oxygen, pH, and surface tension. The observed toxic effects are likely to be due to xenobiotic stress rather than altered physical factors in the environment. (Moore-IVI)
W84-02778

HISTOLOGICAL ALTERATIONS IN LIVER AND INTESTINE OF TELEOST SAROTHERODON MOSSABICUS IN RESPONSE TO MERCURY TOXICITY,
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
K. A. Naidu, K. A. Naidu, and R. Ramamurthi.
Ecotoxicology and Environmental Safety, Vol. 7, No. 6, p 566-575, December, 1983. 18 Fig, 12 Ref.

Descriptors: *Toxicity, *Mercury, *Liver, *Intestine, *Sarotherodon, Fish, Heavy metals.

Effects of lethal (1.5 ppm) and sublethal (0.1 ppm) concentrations of HgCl2 on liver and intestine tissues of Sarotherodon mossambicus were studied by routine histological techniques. Engorged blood sinusoid, vacuolation, rupture, granular degeneration of hepatocytes, edema, focal necrosis, and proliferation of fibroblasts were the alterations observed in liver. Rupture of the tips of the villi, proliferation of villi, increase in goblet cell population, and focal necrosis of villi were the characteristic changes in intestine. (Author's abstract)
W84-02779

EFFECT OF RURAL HIGHWAY RUNOFF ON STREAM BENTHIC MACROINVERTEBRATES,
Wisconsin Univ.-Milwaukee. Dept. of Zoology.
M. E. Smith, and J. L. Kaster.
Environmental Pollution (Series A), Vol. 32, No. 3, p 157-170, 1983. 3 Fig, 4 Tab, 21 Ref.

Descriptors: *Highway effects, *Runoff, *Invertebrates, Stream pollution, Water pollution effects, Biomass, Abundance, Benthos, Wisconsin.

The impact of rural highway runoff on benthic macroinvertebrate abundance and composition was studied in a southeastern Wisconsin, USA, stream during 1980-81. The study suggests minimal effect on stream macroinvertebrates by rural highway runoff from roadways of 7000-8000 vehicles per day traffic volume. Differences in mean annual numbers and biomass between the control (4155/sq m, 10.5 g/sq m) and the station receiving slight highway runoff (2611/sq m, 5.2 g/sq m), presumably resulted from slower current and siltation at the latter. The station which received the greatest amount of runoff had higher mean annual numbers (13291/sq m) and biomass (62.2 g/sq m) than the control. Increased current and better substratum were probably responsible for masking potential highway effects at this station. Another station with intermediate amounts of highway runoff had similar annual mean numbers (4642/sq m) and biomass (10.6 g/sq m) to the control. Similar values for richness were found between stations. Pollution sensitive fauna were approximately half as abundant at the station with intermediate amounts of highway runoff, suggesting possible slight runoff influence. (Author's abstract)
W84-02784

COMPARATIVE STUDIES ON THE ABSORPTION OF CADMIUM AND COPPER IN LEMNA PAUCICOSTATA,
Shinshu Univ., Matsumoto (Japan). Dept. of Public Health.
Y. Nasu, M. Kugimoto, O. Tanaka, and A. Takimoto.
Environmental Pollution (Series A), Vol. 32, No. 3, p 201-209, 1983. 4 Fig, 15 Ref.

Descriptors: *Duckweed, *Cadmium, *Copper, Hydrogen ion concentration, Aquatic plants, Bioindicators, Ammonium, EDTA, Wastewater, Chelating agents.

Absorption of copper or cadmium in the duckweed Lemna paucicostata (strain 6746) was suppressed by the addition of EDTA to the medium. Only 30 micro M of EDTA was sufficient to prevent the absorption of copper at a concentration of 5-10 micro M whereas 400 micro M of EDTA was necessary to prevent the absorption of cadmium at the same concentration as copper. Ammonium ion added to the medium greatly suppressed copper absorption, but cadmium absorption was only slightly suppressed. The growth of Lemna was inhibited in proportion to the amount of copper or cadmium absorbed. The absorption of cadmium was higher, the higher the initial pH of the medium, but that of copper was not significantly affected by the initial pH between 3.6 and 5.1. Both cadmium and copper inhibited plant growth more strongly at pH 5.1 than at pH 4.1. The absorption mechanism and the mode of action of cadmium seem to differ from those of copper in Lemna paucicostata 6746. Ammonium ions and chelating agents commonly exist in rivers, wastewater and lakes, and the pH of these waters also varies with the kind of pollution they contain. Therefore, when Lemna is to be used as an indicator of water pollution or to purify wastewater, the condition of the water must be taken into account. (Moore-IVI)
W84-02785

RELATIONSHIPS OF ENVIRONMENTAL CONTAMINANTS TO REPRODUCTIVE SUCCESS IN RED-BREASTED MERGANSERS MERGUS SERRATOR FROM LAKE MICHIGAN,
Fish and Wildlife Service, Laurel, MD. Patuxent Wildlife Research Center.
G. H. Heinz, S. D. Haseltine, W. L. Reichel, and G. L. Hensler.
Environmental Pollution (Series A), Vol. 32, No. 3, p 211-232, 1983. 1 Fig, 2 Tab, 49 Ref.

Descriptors: *Ducks, *Reproduction, *Lake Michigan, *Water pollution effects, *Mergansers, Mortality, DDE, Pesticides, Behavior, Wisconsin.

For many years Lake Michigan has been known to be heavily contaminated with man-made chemicals. Red-breasted mergansers (Mergus serrator) nesting on islands in northwestern Lake Michigan were studied in 1977 and 1978 to determine whether environmental contaminants were having effects on reproduction. The studies were conducted on Spider, Pilot, Hog, Gravel and Plum Islands, off the tip of Door County, Wisconsin. Seventeen contaminants were measured in randomly chosen eggs from 206 nests under study. A variety of statistical approaches were used to study the effects of individual contaminants and combinations of contaminants on reproductive measurements such as nest desertion, failure of eggs to hatch, death of newly hatched ducklings, percentage hatching success, number of ducklings leaving the nest and eggshell thickness. Relationships between the levels of some contaminants in blood samples of 39 incubating females and reproductive success were examined. A small degree of eggshell thinning was attributed to DDE and a few other statistical tests were significant, but no contaminant or combination of contaminants measured seemed to have a pronounced effect on these aspects of reproduction. (Moore-IVI)
W84-02786

EFFECTS OF PCB ON THE ADRENERGIC RESPONSE IN PERFUSED GILLS AND ON LEVELS OF MUSCLE GLYCOGEN IN RAINBOW TROUT (SALMO GAIRDNERI RICH.),
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
A. Kiessling, P. Part, and K. Lindahl-Kiessling.
Bulletin of Environmental Contamination and Toxicology, Vol. 31, No. 6, p 712-718, December, 1983. 4 Tab, 32 Ref.

Descriptors: *Polychlorinated biphenyls, *Trout, *Toxicity, Organic compounds, Industrial wastes.

Whether polychlorinated biphenyls (PCB) influence the adrenaline response in gills and/or glycogen storage in muscle was investigated using perfused gill preparations from PCB exposed rainbow trout. Experimental groups of 25 fish of both sexes were randomly selected and fed a total amount of 0.173 g PCB during a six day period. The response to adrenaline consisted of a major alpha-adrenergic vasoconstriction followed by a small betadilatation. There was no difference in adrenergic response in the gill vascular bed between PCB-exposed fish and the controls. In the presence of phentolamine, an alpha-adrenergic antagonist, adrenaline decreased gill vascular resistance significantly in both groups. No starvation effect on the levels of glycogen in the muscle were noted, although the fish were starved throughout the experimental period of 38 days. (Baker-IVI)
W84-02835

THE RISKS OF DRINKING WATER,
Harvard Univ., Cambridge, MA. Energy and Environmental Policy Center.

For primary bibliographic entry see Field 5F.
W84-02839

DETOXIFICATION OF ENVIRONMENTAL COPPER IN THE COMMON MUSSEL,
F. L. Harrison.
Energy and Technology Review, p 9-19, November, 1983. 6 Fig, 5 Tab, 12 Ref.

Descriptors: *Copper, *Mussels, *Water pollution effects, Mytilus edulis, Metals, Detoxification, Proteins, Chemical reactions, Metallothionein, Lysosomes.

Two mechanisms of metal detoxification were examined, the binding of copper to metallothionein-like proteins and the incorporation of copper into lysosome-like vesicles. Cells in the digestive gland and other soft tissues of mussels were examined following exposure to the range of copper actually associated with polluted ecosystems. The first step was to determine whether there were increased metals in the low-molecular weight fraction of metal binding proteins. The second was to evaluate the cytological effects of copper on lysosomes by measuring the unavailability for reaction of the lysosomal enzyme hexosaminidase. Changes were noted in the kinds and quantities of copper-binding proteins and in the latency of lysosomal enzymes occurring in the digestive gland cells of Mytilus edulis exposed to metals. Chronic exposure to copper resulted in copper concentrations in low molecular weight metallothionein-like proteins that were dependent on the exposure concentration and time. The copper concentration associated with high-molecular-weight proteins is directly related to the mortality of mussels. Copper exposure also results in a dose dependent reduction in the latency of lysosomal hexosaminidase activity. Exposure to sublethal concentrations of copper thus produces cytotoxic responses that appear to induce stress syndromes such as reduced body weight, low reproduction, and increased incidence of disease. (Baker-IVI)
W84-02931

A SITE-SPECIFIC FIELD AND LABORATORY EVALUATION OF FISH AND ASIATIC CLAM POPULATION RESPONSES TO COAL FIRED POWER PLANT DISCHARGES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, Jr., and D. S. Cherry.
Water Science and Technology, Vol. 15, p 31-58, 1983. 8 Fig, 7 Tab, 36 Ref.

Descriptors: *Field tests, *Laboratories tests, *Fish populations, Asiatic clams, Populations, *Coal fired power plants, *Wastes, Fish behavior, Ecological effects, Thermal stress, Heated water.

A combined effort of field receiving system monitoring and field located laboratory and formal laboratory bioassay testing was used to evaluate and compare responses of fish and the Asiatic clam (Corbicula fluminea) to power plant discharges. Discharges and effluents during an 8-yr period included thermal and chlorinated discharges and pH excursions from fly ash effluent released into a lotic receiving system of the New River drainage in Glen Lyn, Virginia, USA. Constituents within the fly ash effluent included the effects of the particulate ash fraction, heavy metals, and pH (acidic and alkaline) excursions. The field laboratory tested fish preference-avoidance behavior and lethal temperature responses to elevated temperatures in chlorinated, thermal plumes. The fish populations preferred and avoided heated waters, depending on their seasonal acclimation requirements. Fish populations avoided sublethal chlorinated discharges from laboratory intermittent chlorine bioassays after attraction into the laboratory and field thermal plumes. From October 1976-September 1978, Asiatic clams were more numerous in the vicinity of the thermal discharge of the plant than they were in unheated waters, and their population fell sharply during winter months when the water temperature dropped to approximately 2 degrees C. The temperature (35 degrees C) of the heated discharge water in late summer did not adversely affect the clam since in laboratory thermal tolerance studies mortality occurred at temperatures > or = to 36 degrees C. The clam proved to be highly resistant to the conventional biocidal practice of intermittent chlorination and to exposure to heavy metals in both static and artificial stream bioassays. Copper was more toxic than either zinc or a combination of zinc and copper. Potassium was not an effective biocidal (gaping) agent at low concentrations (<100 mg/l). Only minor incidents of Corbicula infestation were in the cooling system of the power plant, The ability of the clam to use heated discharge areas as overwintering sites has allowed them to expand their range into frozen northern aquatic systems of the USA. (Murphy-IVI)
W84-02935

IMPACT OF THERMAL POWER PLANTS ON AQUATIC ECOSYSTEMS: THE FRENCH EXPERIENCE,
Electricite de France, Chatou.
R. A. Gras.
Water Science and Technology, Vol. 15, No. 10, p 59-66, 1983. 2 Ref.

Descriptors: *Powerplants, *Thermal pollution, *Environmental effects, *Ecosystems, Fish, Public health, Aquatic life, France, Dissolved oxygen, Phytoplankton, Bacteria, Zooplankton, Plankton.

Field studies were conducted on the site of power plants currently in operation. These included Montereau powerplant, Bugey power plant, La Maxe power plant, Porcheville power plant, Saint-Laurent-des-Eaux power plant, Chinon power plant, Loire-sur-Phone power plant, and Les Ansereuilles power plant. Power plants by the sea which were studied included Dunkirk power plant, Martigues-Ponteau, and Gravelines. Power plants located on estuaries were also studied including Blayais, Cordemais and Ambes. Chemical wastes from the power plants are not released in sufficient quantity to significantly alter water quality. However waste heat may affect water quality either through direct impact causing a decrease in dissolved oxygen content or indirect impact caused by the long term changes in water temperature altering various components of the dissolved oxygen balance such as an increase in aeration at the water surface, a decrease in dissolved oxygen saturation level and other effects. Impacts on phytoplankton, zooplankton, and bacteria are reviewed. Sanitary effects are considered including those affecting public health, and fish parasites. (Baker-IVI)
W84-02936

THERMAL DISCHARGE AND FISH FAUNA IN SWEDEN,
National Swedish Environment Protection Board, Oregrund. Coastal Water Section.
E. Neuman.
Water Science and Technology, Vol. 15, p 67-87, 1983. 11 Fig, 7 Tab, 19 Ref.

Descriptors: *Heated water, *Fish, *Sweden, Fish behavior, Thermal stress, Thermal pollution, Thermal powerplants, Fish populations.

Investigations on the fish fauna at four thermal power plants in Sweden situated on Lake Malaren, the Baltic, the Sound and the Kattegatt, illustrate effects of thermal discharge in various salinities, from fresh water to above 20%. The most common species are classified as warm- or cold-water fishes on the basis of the catch/temperature relationship. The reactions towards the cooling-water mainly correspond to this grouping. There are exceptions due to special hydrographic conditions and to the supply of food. Shallow bottoms in freshwaters and at the Baltic coast are massively dominated by warm-water species of freshwater origin, while marine cold-water fishes hold a strong position in the higher salinities of the Sound and the coast of the Kattegatt. The effects of thermal discharge upon the species composition increases with salinity. (Murphy-IVI)
W84-02937

BIOLOGICAL MONITORING OF THERMAL EFFECTS OF COOLING WATER DISCHARGES FROM DANISH POWER PLANTS,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
B. Moller, and K. I. Dahl-Madsen.
Water Science and Technology, Vol. 15, p 89-99, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Biological monitoring, *Ecological effects, *Cooling water, *Thermal powerplants, Heated water, Thermal pollution, Water quality management, Water quality standards, Bioindicators.

In the years from 1970-1982 52 site studies and monitoring studies have been carried out at major existing and planned power plants, in order to plan a system for water quality. An important part of the planning system is the description of size and distribution of excess temperature fields and the related biological conditions. In the biological monitoring, emphasis is placed on the benthic community as more vulnerable to the cooling water discharge. The studies have shown that the excess temperature field within the 1-2 degree isotherm can produce measurable changes in the benthic community. The temperature effect in the pelagic zone is marginal, however, some effects are seen at sites with a deep water intake of nutrient rich water. Entrainment of fish and zooplankton can be important in bays and estuaries. (Murphy-IVI)
W84-02938

THE ROLE OF FREE-LIVING AMOEBAE OCCURRING IN HEATED EFFLUENTS AS CAUSATIVE AGENTS OF HUMAN DISEASE,
Pittsburgh Univ., PA. Graduate School of Public Health.
M. A. Shapiro, M. H. Karol, G. Keleti, J. L. Sykora, and A. J. Martinez.
Water Science and Technology, Vol. 15, p 135-147, 1983. 6 Tab, 21 Ref.

Descriptors: *Amoebae, *Heated effluents, *Causative agents, *Human Disease, Pathogenic organisms, Pathogens, Naegleria fowleri, Primary amoebic meningoencephalitis, Acanthamoeba, Granulomatous amoebic encephalitis, Coal fired powerplants, Cooling towers, Powerplants, Thermal pollution.

Several pathogenic organisms may be frequently found in thermal effluents and cooling systems of coal fired power plants, including pathogenic Naegleria fowleri, the causative agent of an acute fatal human disease - primary amoebic meningoencephalitis (PAM). Two out of eight power plants investigated, harbored pathogenic N. fowleri in heated water or cooling towers. The occurrence of this organism was related to elevated temperatures. No significant correlation was found for other biological and chemical parameters. In addition, pathogenic Acanthamoeba which causes granulomatous amoebic encephalitis (GAE) was found in heated effluents from coal fired power plants. Nonpathogenic strains of N. fowleri as well as other free-living and 'harmless' amoebae were also very abundant in effluents from all investigated coal fired power plants and cooling towers. Several species of nonpathogenic amoebae were isolated from humidifiers and air conditioning systems. Serological testing of symptomatic human subjects has indicated that these organisms may be one of the causative agents of hypersensitivity pneumonitis. Antibodies were detected in all sensitized animals. All the sensitized animals displayed delayed onset respiratory responses. Not only pathogenic but also non-pathogenic free-living amoebae may be important causative agents of human disease. The occurrence of these organisms in cooling systems from coal fired power plants indicates that these facilities may be an important source of infection. (Murphy-IVI)
W84-02940

PREDICTING THE IMPACT OF POWER PLANTS DISCHARGES ON THE WATER QUALITY OF A RIVER WITH THE AID OF A MATHEMATICAL MODEL,
Electricite de France, Chatou. Direction des Etudes et Recherches.
Ph. Gosse.

Water Science and Technology, Vol. 15, No. 10, p 149-160, 1983. 8 Fig, 15 Ref.

Descriptors: *Powerplants, *Thermal pollution, *Water quality, *Mathematical models, Phytoplankton, Dissolved oxygen, Turbidity, Plankton, Biomass, Model studies, Rivers.

The development of large once-through cooling power plants has raised the issue of the dispersion of residual heat and of the thermal assimilative capacity of the receiving waters. Important experimental studies dealing with this impact have been undertaken since 1972 on three large rivers. The immediate effects of such plants is limited. In general, dissolved oxygen content and turbidity were not directly affected by the transit, but may be locally modified in accordance with the geometric properties of the intake or outlet channels. Border, Champ, Lair and Pourriot noticed no significant changes in the diversity and concentration of phytoplankton and zooplankton biomass before and after passage through the condensers of their powerplants. Long term alterations include possible acceleration in the kinetics of pollution decay, increases in the productivity of phytoplankton when temperatures are lower than 25 degrees C, modification of the dissolved oxygen content due to algal and bacterial activity, and possible increases in thermophile zooplankton populations. (Baker-IVI)
W84-02941

MODELLING THE CONSEQUENCE OF COOLING WATER DISCHARGE FROM THE 'VENDSYSSEL' POWER PLANT,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
A. Malmgren-Hansen, and K. I. Dahl-Madsen.
Water Science and Technology, Vol. 15, p 177-196, 1983. 15 Fig, 11 Ref.

Descriptors: *Mathematical models, *Cooling water, *Thermal pollution, *Vendsyssel power plant, Ecological effects, Zooplankton-growth model, 1-dimensional hydraulic model, Eutrophication model, Water quality management.

Discharge of cooling water from power plants has various effects on the ecosystem in coastal areas. The effect on primary production due to the rise in temperature in the outlet area and the decimation of zooplankton organisms passing through the cooling system of the power plant can be calculated by means of mathematical models. Calculations of the consequences of a considerable increase in cooling water discharge from the 'Vendsyssel' power plant allows power plant planners to evaluate the possibility of violation of emission standards for the receiving area. The decimation of zooplankton is calculated by means of a combined 2-dimensional hydraulic and zooplankton-growth model. Calculations of the effects on primary production are carried out by use of a combined 1-dimensional hydraulic and eutrophication model. (Murphy-IVI)
W84-02943

MACROBENTHIC COMMUNITIES OF THE LOWER CHESAPEAKE BAY. III. SOUTHERN BRANCH OF THE ELIZABETH RIVER. BENTHIC STUDIES OF THE LOWER CHESAPEAKE BAY 6,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
S. D. Hawthorne, and D. M. Dauer.
Internationale Revue der gesamten Hydrobiologie, Vol. 68, No. 2, p 193-205, 1983. 4 Fig, 5 Tab, 23 Ref.

Descriptors: *Benthic environment, *Water pollution effects, *Harbors, *Chesapeake Bay, *Elizabeth River, Virginia, Estuaries, Sedimentation, Water quality, Invertebrates.

Macrobenthic invertebrates of an industrialized seaport ecosystem were studied seasonally from October, 1977 through July, 1978. Five stations were selected along the Southern Branch of the Elizabeth River, Virginia. Poly- to mesahaline conditions occurred in this estuary. Slightly acidic waters existed in the upper reaches of the study area due to drainage of tannic acids produced within the Great Dismal Swamp. Dissolved oxygen was relatively good throughout the study. From 70 grab samples collected at five stations, 11,667 individuals were obtained. They were identified to 60 taxa, of which 53 were identified to species. The number of species observed at a station ranged from 9 to 27. Spatial homogeneity was very high throughout the Southern Branch. Slightly acidic waters did not affect the community structure in the southern most reach. Temporal heterogeneity was also high with some variations due to habitat alteration and/or reproductive recruitment. A considerable increase in sand content was noted, corresponding with maintenance dredging of the river. No signficiant alterations in the benthic community occurred due to the sediment alteration. Benthic communities of estuaries, particularly in the lower polyhaline to mesohaline zones, are dominated by eurytopic species that are probably affected only by severe stresses induced by man's activities. (Baker-IVI)
W84-02950

5D. Waste Treatment Processes

LAND APPLICATION: A NEW APPROACH TO PLANT EFFLUENT TREATMENT,
Law Engineering Testing Co., Marietta, GA.
G. L. Taylor, L. A. Neal, and N. Dee.
Pulp and Paper, Vol. 57, No. 3, p 81-84, March, 1983. 3 Fig, 9 Ref.

Descriptors: *Land disposal, *Pulp wastes, Pulp and paper industry, Kraft mills, Industrial wastes, Wastewater treatment, Sludge disposal.

Design criteria have been developed to allow land treatment of many pulp and paper wastes including sludges and residues, primary and secondary treatment plant effluents, total mill raw waste, and leachate from onsite sludge landfills. Four major techniques of waste application include rapid infiltration, overland flow, spray irrigation, and soil incorporation. Pretreatment of waste prior to land application may be appropriate if it can be economically justified. One potential problem of land treatment systems is the possibility of not being able to operate them during inclement weather periods. A waste characterization study must be performed to determine the amount of land needed for adequate assimilation of waste in the soil. Land treatment does present an efficient process for color removal. (Baker-IVI)
W84-02511

REUSE OF WARM WATER ON PAPER MACHINE PAYS OFF AT MADISON,
Jordan (Edward C.) Co., Inc., Portland, ME.
H. L. Laskey, and E. R. Drechsel.
Pulp and Paper, Vol. 57, No. 9, p 46-47, September, 1983. 1 Fig, 1 Tab.

Descriptors: *Pulp and paper industry, *Water reuse, Industrial wastes, Cooling water, Cost benefit analysis, Whitewater, Pumping, Water conservation.

Major effluent problems arose with the replacement of an existing 100-tpd groundwater mill with a 250-tpd pressurized groundwood mill along with the addition of a 600-tpd paper machine to the existing 120-tpd paper machine capacity. A water conservation plan was developed to recover and re-use the warmed water from the cooling systems, to control lantern ring seal water use, to vacuum pump seal water provided from separators on vacuum lines, to filter backwash discharged directly to the river, to get maximum re-use of whitewater and use of high pressure freshwater showers, to devise a whitewater storage system and to employ water conservation steps at existing operations. Heat recovered from the warm water collection system is about 63% of the total heat recovered. Total recovered heat of 63,100,000 Btu/hour is worth $2,650,000 per year. Installed cost for the warm water collection piping was $61,000. All new mills should be designed with a complete clean cooling water reuse system. Existing mills would also realize a good return on investment by installing a clean arm water collection and reuse system. Additional benefits include decreased cost of pumping freshwater and decreased flow to the water treatment plant. (Baker-IVI)
W84-02512

CHARACTERISTICS OF ACTIVATED SLUDGE EFFLUENTS BEFORE AND AFTER BREAKPOINT CHLORINATION,
Clemson Univ., SC. Coll. of Engineering.
B. Trgovcich, E. J. Kirsch, and C. P. L. Grady, Jr.
Journal of the Water Pollution Control Federation, Vol. 55, No. 7, p 966-976, July, 1983. 8 Fig, 8 Tab, 29 Ref. NSF grant CME 77-12649.

Descriptors: *Sludge, *Chlorination, *Activated sludge process, *Effluents, Acidity, Dissolved oxygen, Wastewater treatment, Biodegradation, Organic matter, Hydrogen ion concentration, Dissolved oxygen.

Attempts were made to alter the quality of the organic matter leaving an activated sludge reactor through control of operational variables such as pH and dissolved oxygen (DO) concentration. Data collected from lab-scale activated sludge reactors has shown that while factors internal to the culture are the primary determinants of effluent character as evaluated by adsorptability, molecular size, and biodegradability, pH and DO concentrations did not have much effect as control variables on those factors. If the effluent is to be subjected to breakpoint chlorination, then the pH of the activated sludge reactor will influence the adsorptability of the organics remaining after chlorination. Operation of the activated sludge reactors at a DP concentration of 7 mg/L resulted in effluent organics that were less resistant to biodegradation than those produced at a DO concentration of 1 mg/L, both before and after breakpoint chlorination. Chlorination adversely affected biodegradibility. (Baker-IVI)
W84-02563

STEP PRESSURE SEWERS ARE A VIABLE WASTEWATER COLLECTION ALTERNATIVE,
Winzler and Kelly, Eureka, CA.
D. J. Tollefson, and R. F. Kelly.
Journal of the Water Pollution Control Federation, Vol. 55, No. 7, p 1004-1014, July, 1983. 5 Fig, 5 Tab, 5 Ref.

Descriptors: *Wastewater collection, *Sewer systems, *STEP pressure sewers, Septic tanks, Design criteria, Wastewater treatment, Construction costs, Groundwater pollution, Water pollution control, Bacteria, Manila, California.

The available information on low-pressure septic tank effluent pumping (STEP) sewer system was reviewed. STEP pressure sewers proved to be a viable alternative to conventional methods of wastewater collection under some conditions such as high ground water, undulating terrain, unstable soil or rock conditions, and rural community nature. Hydraulic design of STEP systems deserves careful attention so as to minimize construction cost and on-going costs. STEP collection system operation and maintenance costs total about $5.50 per customer per month of which $1.35 per month is electrical power related cost. Surface and groundwater samples were collected and analyzed for fecal coliform bacteria from system start-up through the monitoring program to assess the effect of the system on water quality. A significant improvement in groundwater quality resulted from construction of the STEP collection system in Manila, California. (Baker-IVI)
W84-02564

COST OF CLEAN WATER--IMPACT ON SMALL COMMUNITIES,
McNamee, Porter and Seeley, Ann Arbor, MI.
R. J. Smit, and W. A. Chapin.
Journal of the Water Pollution Control Federation, Vol. 55, No. 5, p 444-447, May, 1983. 3 Fig, 3 Tab, 5 Ref.

Descriptors: *Wastewater treatment facilities, *Construction costs, Grants, Loans, Small communities, Water pollution control, Income, Economic aspects.

The impact of grant reductions and changes in the classification of eligible project costs resulting from the Municipal Wastewater Treatment Grant Amendments of 1981 will significantly affect small communities. Owing to the state priority systems and other factors, small communities have received a disproportionately small share of EPA grants in terms of numbers and dollars. A substantial backlog of necessary water pollution control projects in small communities and scheduled reductions in the construction grants program make it likely that many small communities will have to construct their improvements with reduced grant support or none at all. This prospect may place the cost of wastewater treatment outside the reach of many small communities. Because annual household costs for wastewater treatment in smaller communities are higher than in large ones, and the median household income is generally smaller, the percentage of families that would be burdened by excessive costs for wastewater treatment would be larger. The use of less costly methods of wastewater treatment, such as lagoons or trickling filters, which may be permitted where they do not cause water quality degradation, does reduce user costs. Unfortunately, this substitution will not entirely offset reductions in grant support. Low interest loans, however, such as the 5%, 40-year loans available through the Farmers Home Administration, in combination with a 55% grant, can yield user charges comparable to those under the current 75% grant program. (Moore-IVI)
W84-02565

EFFECTS OF OZONE ON THE BIODEGRADABILITY OF BIOREFRACTORY POLLUTANTS,
D. R. Medley, and E. L. Stover.
Journal of the Water Pollution Control Federation, Vol. 55, No. 5, p 489-494, May, 1983. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Ozonation, *Wastewater treatment, Biodegradation, 1,2-Dichloropropane, 2,4-Dinitrophenol, Acrylonitrile, Industrial wastes, Oxidation, Phenols.

The effect of ozone on biodegradability of acrylonitrile, 1,2-dichloropropane, and 2,4-dinitrophenol was investigated. Acrylonitrile was not readily oxidized by ozone, even at considerable doses. 1,2-Dichloropropane was oxidized readily at very small ozone doses. TOC and COD followed an almost linear decreasing relationship with increasing absorbed ozone concentrations. Unozonated, 1,2-dichloropropane was totally resistant to biodegradation showing zero ultimate BOD with the acclimated seeds. 2,4-Dinitrophenol was not oxidized to a great extent by low ozone doses. Ozonation was effective in increasing the biodegradation of 2,4-dinitrophenol, with the increase being proportional to adsorbed ozone dose. Biological oxidation is possible for 2,4-dinitrophenol if concentrations are below inhibitory levels. Ozonation of 2,4-dinitrophenol prior to biological oxidation increases biodegradation and reduces inhibitory levels. Ozone is not a cure-all for difficult to biodegrade pollutants. Studies must be conducted on each compound to determine if it is effective or economically feasible to increase biodegradation or to oxidize the compound completely. (Baker-IVI)
W84-02566

CAPACITY OF NATURAL WETLANDS TO REMOVE NUTRIENTS FROM WASTEWATER,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
D. S. Nichols.
Journal of the Water Pollution Control Federation, Vol. 55, No, 5, p 495-505, May, 1983. 4 Fig, 2 Tab, 125 Ref.

Descriptors: *Wastewater treatment, *Land disposal, *Nutrients, Phosphorus Nitrogen, Wetlands, Aluminum, Iron, Calcium, Minerals, Clays, Denitrification, Adsorption.

Application of treated wastewater to wetlands is gaining attention as a simple method and energy-efficient way of nutrient removal. Wetlands retain wastewater P by adsorption and precipitation reactions with Al, Fe, and Ca in the soil. Adsorption/precipitation is not a limitless sink, and with continued application, the capacity of wetland soils to retain P declines as the soils become saturated. Adsorption is at least partially reversible. Some P that is adsorbed from the water at high concentrations can be released to the water when P levels are lower. Wastewater N is removed by denitrification in the wetland soil. Denitrification is dependent on a supply of available organic carbon. In typical wetlands with large amounts of organic matter in the soil, N removal does not seem to decline with time, in contrast to P removal. Wetland vegetation can adsorb large quantities of N and P during the growing season, but much of it is released to the water when the plants die. The removal of wastewater N and P by wetlands is most efficient at low N and P loading rates. Removal efficiency of both N and P falls off rapidly as loadings are increased. On the average, perhaps 1 ha of wetland is required to remove 50% of the N and P from the wastewater produced by 60 people. Much larger wetland areas are needed for higher removal efficiency. Application to natural wetlands can be an efficient method of wastewater nutrient removal if wetland is abundant and populations are low. (Baker-IVI)
W84-02567

FACTORS AFFECTING FINE BUBBLE DIFFUSED AERATION,
Rexnord, Inc., Milwaukee, WI.
G. L. Huibregtse, T. C. Rooney, and R. C. Rasmussen.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1057-1064, August, 1983. 10 Fig, 5 Ref.

Descriptors: *Wastewater treatment, *Aeration, Bubbles, Activated sludge processes, Efficiency, Evaluation, Systems analysis, Oxygen transfer.

To better understand factors that affect the performance of a fine bubble system, a series of clean water, unsteady-state, oxygen transfer tests was conducted. The major objective of the study was to provide comparative data under similar conditions for different shapes and configurations of fine bubble diffused aeration equipment. The program evaluated both a disc- and dome-type diffuser installed in a total-floor-coverage type configuration. Using the disc diffuser, testing was also conducted to determine the effect of diffuser size, as well as the installation density. Fine bubble tubes were also tested under the same conditions. For a fine-bubble-grid type system, percent oxygen transfer will be dependent on the liquid depth, diffuser shape and size, air flow rate per diffuser, and the number of diffusers installed. When system performance was measured in terms of overall aeration efficiency, the same test variables, with the exception of liquid depth, were found to have similar effects. Liquid depth had no significant effect on aeration efficiency. For a fine bubble tube system, performance will be dependent on the liquid depth, the air flow rate per tube, and the number of headers. Best test results were obtained with a dual header system at a low air flow rate per tube and at greater depths. (Baker-IVI)
W84-02573

EFFECTS OF DISSOLVED OXYGEN AND MIXING ON ALGAL AUTOFLOTATION,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. Arbelaez, B. Koopman, and E. P. Lincoln.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1075-1079, August, 1983. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Wastewater treatment, *Algae, *Autoflotation, Dissolved oxygen, Mixing, Cultivation, Animal wastes, Flotation, High-rate ponds.

Pig wastewater influent to a high-rate pond was pre-treated by settling only. The autoflotation test apparatus consisted of an inlet and pump, plug flow reactor, and flotation cylinder. Data from all flotation trials were grouped according to the following contact times: 0.02 to 0.1, 0.1 to 1.0, 1.0 to 20, 20 to 100, 100 to 200, and greater than 200 seconds. Rise rates are highly sensitive to contact time at small values of contact time (0.02 to 20 seconds), but relatively insensitive at higher values of contact time. Velocity gradient and contact time were identified as important parameters in algal autoflotation. The theory that their product provides a single parameter that should correlate well with all results of flotation trials was tested. Velocity was shown to be inversely and consistently related to the product of the two parameters. However, the variability at the lowest product ranges indicates either instability of flotation in this regime or unequal importance of velocity and contact time in determining flotation performance. (Baker-IVI)
W84-02575

METRO ATLANTA WATER POLLUTION CONTROL - A DECADE OF PROGRESS,
R. Troxler, D. Reinhart, and A. Hallum.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1121-1127, September, 1983. 7 Fig, 2 Tab.

Descriptors: *Wastewater treatment facilities, *Water pollution control, *Atlanta, Georgia, Chattahoochee River, Peachtree Creek, DeKalb County, Cobb County, Lake Lanier, South River, Jackson Lake, Yellow River, Flint River, Etowah River, River basins.

Dramatic progress has been made during the past 10 years toward improved water quality using a variety of technical solutions for the city of Atlanta, Georgia. In the Chattahoochee River Basin, even though four wastewater treatment plants discharge into the reach above Peachtree Creek, the major water quality problems are from urban runoff and construction-generated sediment. The quality of the water decreases severely below Peachtree Creek, with the river receiving the discharges from five major wastewater treatment plants. Improvement in this area has been largely due to the addition of secondary treatment capability at the R. M. Clayton Plant in Atlanta, one of the largest treatment facilities in the southeast. The South River Basin has received severely polluted discharges from Atlanta and DeKalb County and large blooms of algae each year during the summer and fall in Jackson Lake have only added to the problem. Steps for better control in this area include construction of an above ground storage facility at the site of a third major combined sewer overflow point in the South River Basin. The screened and degritted effluent from this facility will be discharged into a separate sanitary sewer that is tributary to the South River Plant. Specific efforts have also been made in the Yellow River Basin, the Flint River Basin and the Etowah River Basin. (Baker-IVI)
W84-02580

A QUALITY ASSURANCE PROGRAM AT A MUNICIPAL WASTEWATER TREATMENT PLANT LABORATORY,
Milwaukee Metropolitan Sewerage District, WI. Treatment Services Div.
G. A. Aldenhoff, and L. A. Ernest.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1132-1137, August, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Water quality control, *Wastewater treatment facilities, Municipal wastewater, Quality control, Milwaukee, Wisconsin, Maintenance, Management, Planning.

The Milwaukee Metropolitan Sewerage District (MMSD) laboratories monitor wastewater treatment plant processes, provide research support, analyze industrial waste contributions, evaluate water quality variables in receiving streams and Lake Michigan, and measure the constituents of solids generated by the treatment plants' processes. The MSSD concentrates its quality assurance program on the individual analyst and his daily con-

trols. Each analyst is responsible for quality control in his area. He determines and controls the quality of the physical, chemical, or biological measurement, as well as data handling, reporting, and visual representation of that data. To establish precision, a regular program of duplicate and replicate analyses is carried out. Although precision testing verifies the repeatability of the method, it does not guarantee accuracy. This is accomplished by analyses of check standards and spikes and shows the degree of difference between the observed and the known or true values. Control charts in use at the district are of three types: one for duplicate analysis, a second for recoveries of standards, and a third for recoveries in spiked samples. Control charts are the last step taken by the analyst at the end of each day's run. They are specifically designed to make him aware of what the limits are, whether or not the system is in control, and whether or not a pattern of impending trouble is occurring. (Baker-IVI)
W84-02581

COMPREHENSIVE PROGRAM FOR SURVEILLANCE OF PACKAGE PLANTS AND STABILIZATION PONDS,
Mid-Ohio Valley Health Dept., Parkersburg, WV.
R. G. Weigand.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1138-1143, September, 1983. 2 Fig, 2 Tab, 3 Ref.

Descriptors: *Quality control, *Wastewater treatment facilities, Stabilization ponds, Monitoring, Water pollution control, Planning, Management, Maintenance, West Virginia, Wood County.

Since its inception in 1975 the small wastewater treatment system surveillance program of the Wood County Health Department (West Virginia) currently in place has expanded to involve not only operation and maintenance inspections, but plan review, site review, and construction inspections. The main thrust of the program lies with routine maintenance inspections performed semiannually at each plant and stabilization pond. Detailed inspection forms that stress routine maintenance activities have been created to aid the inspector and operator. Strong emphasis on proper planning and construction resulted in fewer serious maintenance problems, and plants that are more operable. The heavy emphasis placed on operator training is evidenced by the significant increase in certified operators since the program began. Where maintenance deficiencies are noted, the technical assistance approach has been much more successful than has the enforcement approach for obtaining compliance. Although most effluent analyses are limited to portable kits for parameters such as pH, alkalinity, and chlorine residual, a dissolved oxygen meter has been useful in monitoring oxygen levels in mixed liquor samples. Further study is needed to examine the efficiency and overall success of different management structures for these small wastewater systems. Additional work also is needed to determine the feasibility of various filter media being used for surface sand filters. (Baker-IVI)
W84-02582

INEXPENSIVE HEAVY METAL REMOVAL BY FOAM FLOTATION,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
G. McIntyre, J. J. Rodriguez, E. L. Thackston, and D. J. Wilson.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1144-1149, September, 1983. 3 Fig, 6 Tab, 8 Ref.

Descriptors: *Heavy metals, *Foam separation, *Flotation, Wastewater treatment, Industrial wastes, Chromium, Copper, Zinc.

The removal of copper and zinc, mixtures of copper and zinc, and chromium by adsorbing colloid foam flotation was investigated. The method proved feasible for treatment of heavy metals-bearing wastewaters. Effluent concentrations below the 1984 Best Available Technology (BAT) limits can be consistently obtained for all the heavy metals studied, even when dealing with wastes containing mixtures of them. The cost of the process is probably competitive with lime precipitation, and may be considerably less if lime precipitation requires filtration of final effluent, or if the total costs of sludge handling are considered, or if additional land is necessary to accommodate a clarifier. Chemical costs associated with foam flotation are considerably higher than for lime precipitation, but the chemical addition allows much higher areal loading rates, resulting in much lower capital costs for foam flotation. (Baker-IVI)
W84-02583

NITROGEN CONTROL IN DOMESTIC WASTEWATER RAPID INFILTRATION SYSTEMS,
Robert S. Kerr Environmental Research Lab., Ada, OK. Wastewater Management Branch.
L. E. Leach, and C. G. Enfield.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1150-1157, September, 1983. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Domestic wastewater, *Land disposal, *Infiltration, *Nitrogen removal, Wastewater treatment, Nitrates, Sprinklers, Rapid infiltration, Algae, Hydraulic loading.

The effect of flooding and drying scheduling on hydraulic loading and nitrogen removal was investigated. Total nitrogen and nitrate-nitrogen in secondary effluent is effectively reduced and maintained at acceptable levels through rapid infiltration land treatment systems. The most efficient of the four operating schedules evaluated occurred with an operation of 1-day flooding followed by 1-day drying. Long term flooding and the 3-day flooding followed by 4-day drying cycles both performed about equally well hydraulically. Although these cycles were the most efficient for total volume of wastewater treated per unit of time, they were not as efficient for nitrogen control as 1-day cycles; and they presented a problem during the drying cycle with the development of high nitrates in the soil water. High concentrations of nitrogen were flushed through the soil at the beginning of each new flooding cycle. The magnitude of nitrate concentration was greatly reduced in the 1-day cycle operation, compared to the two longer flooding schedules. Bed surface management was also much more efficient. Application of wastewater with sprinklers in 15 minute cycles interrupted by 75 minutes of drying eliminated flushing slugs of high concentrations of nitrogen through the soil system. However, nitrate concentrations were consistently above the 10 mg/l Public Health Service Drinking Water Standard. An alternative conclusion could be made that the most effective scheduling for hydraulic loading was the least effective for nitrogen removal. Removal efficiencies as high as 80% could be achieved if loading were reduced to 15 cm/d, but removal would drop to about 20% if the loading were increased to 50 cm/d. Algal blooms did not develop with operation of the sprinkler system and bed maintenance was not needed, but all flooding operations were plagued by nuisance algal blooms. (Baker-IVI)
W84-02584

CONTROL OF OZONE DISINFECTION BY EXHAUST GAS MONITORING,
Municipal Environmental Research Lab., Cincinnati, OH. Wastewater Research Div.
A. D. Venosa, and M. C. Meckes.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1163-1167, September, 1983. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Ozonation, *Disinfection, Ozone, Wastewater treatment, Secondary wastewater treatment, Activated sludge processes, Contact stabilization, Rotating biological contactors.

Secondary effluent was obtained from six different sources, three of which are conventional activated sludge treatment plants, two are contact stabilization plants, and one uses rotating biological contactors to treat municipal wastewater. Five receive raw wastewater of municipal origin while the sixth receives wastewater with a high concentration of industrial wastes. Disinfection with ozone can controlled by monitoring the exhaust gas ozone concentration exiting the contactor. This method was more reliable than measuring dissolved ozone because of the inherent difficulties and inadequacies of state-of-the-art dissolved residual techniques. The advantages of measuring exhaust gas ozone include: true ozone is being measured free of interferences; ozone demand of the effluent and transfer efficiency of the contactor are automatically accounted for in one measurement; the method is easily automated; instruments are already available on the market for measuring ozone in the gas phase with accuracy, precision, and low level sensitivity; and ozone is more stable in the gaseous phase than in the liquid phase, and consequently the operator does not have to concern himself with dissipation of the zone from the time it leaves the contactor to the time it arrives at the analyzer. (Baker-IVI)
W84-02585

BIODEGRADATION AND ADSORPTION WITHIN ACTIVATED CARBON ADSORBERS,
Zenon Environmental, Inc., Burlington (Ontario).
R. G. Peel, and A. Benedek.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1168-1173, September, 1983. 10 Fig, 29 Ref.

Descriptors: *Wastewater treatment, *Activated carbon, *Adsorbents, *Biodegradation, *Adsorption, Activated sludge process, Filtration,.

In a biologically active carbon filter the two processes of adsorption and biological degradation occur simultaneously and the extent of each is difficult to determine because the processes are not easily isolated without significantly influencing process conditions. When biodegradable organics are present in the influent to an activated carbon column, biochemical oxidation can be presumed to occur when sufficient oxygen is present. If, however, the organic components of the feedstream are relatively non-biodegradable, very little, if any, biochemical oxidation will occur. Activated carbon does not have an inherent bio-enhancement capability, and organics that can be regarded as biorefractory to conventional treatments will also be biorefractory within a biologically active carbon column. The close agreement obtained between the experimental breakthrough curves and the breakthrough curves predicted by the dual-rate kinetic model show that relatively simple modeling approaches using an overall parameter, such as total organic carbon, can be very useful in predicting the behaviour of adsorbers in which the removal of organics is predominantly caused by adsorption. (Baker-IVI)
W84-02586

METALS REMOVALS AND PARTITIONING IN CONVENTIONAL WASTEWATER TREATMENT PLANTS,
Municipal Environmental Research Lab., Cincinnati, OH.
A. C. Petrasek, Jr., and I. J. Kugelman.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1183-1190, September, 1983. 1 Fig, 8 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Metals, *Activated sludge process, Calcium, Silver, Arsenic, Cadmium, Chromium, Copper, Iron, Mercury, Magnesium, Manganese, Nickel, Lead, Zinc, Industrial wastes, Cincinnati, Ohio.

The removal and partitioning of metals normally present in wastewater entering the Mill Creek Wastewater Treatment Plant in Cincinnati were determined in a pilot-scale activated sludge system. Twenty-four hour composite samples were collected for all process flows and sludges throughout the duration of the project. The metals concentrations observed in the primary sludge were generally higher than in the return activated sludge, when considered in units of mg/L. However, on a mg/kg basis the waste activated sludge had higher concentrations. The primary sludge contained 10 to 15% of the metals entering the plants. Waste

activated sludge contained about 30% of the total metals burden. The average removal of the 13 metals studied was 42%, based on the mass balance calculations. Silver, mercury and arsenic were present at very low concentrations in the raw wastewater and proper assessment of removability was not possible. Arsenic removal was 19%. Calcium and magnesium are quite refractory to the biological processes and there was essentially no removal of these metals. Manganese removal for the total treatment sequence was on the average only 39%, with the primary clarifier removing 15% and the activated sludge process removing 27%. Other metals studied included cadmium, chromium, copper, iron, nickel, lead, and zinc. (Baker-IVI)
W84-02588

A PRACTICAL METHOD TO ESTIMATE THE ACETOCLASTIC METHANOGENIC BIOMASS IN ANAEROBIC SLUDGES,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
D. Valcke, and W. Verstraete.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1191-1195, September, 1983. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Anaerobic digestion, *Methane, *Acetate, *Sludge, Wastewater treatment, Activated sludge processes, Sodium acetate, Methanogenesis, Bacteria, Biomass.

The method consists of adding increasing amounts of acetate to a series of sludge samples, thus determining the maximum rate of methane production per liter of mixed liquor. The method is based on the finding that during a maximum of 24 hrs of incubation, biomass growth is minimal and acetate conversion rates obey zero-order kinetics and are not affected by substrate concentrations between certain limits. To convert the determined maximum rate to acetoclastic biomass it is assumed that maximum specific activity is attained. The sludge of an upflow reactor treating wastewater from a flax retting factory was used to verify the test procedure. Different concentrations of sodium acetate were added and monitored for conversion over a 30 hr period. Linear production rates were observed varying from 275 to 425 mL methane/L of mixed liquor/day. Higher sludge concentrations gave higher methane production rates. Acetate is rate-limiting below a sludge load of 0.40 g HAc/g volatile suspended solids, with this particular sludge. Therefore it was necessary to dilute the sludge to a concentration of 5 g VSS/l or less to assure substrate-non-limiting conditions. (Baker-IVI)
W84-02589

EXERTION OF 5-DAY NITROGENOUS OXYGEN DEMAND IN NITRIFYING WASTEWATERS,
Metropolitan Sanitary District of Greater Chicago, IL.
B. Washington, C. Lue-Hing, D. R. Zenz, K. C. Rao, and A. W. Obayashi.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1196-1200, September, 1983. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Nitrification, *Oxygen demand, Wastewater treatment facilities, Wastewater treatment, Domestic wastes, Chicago, Illinois, Municipal wastes, Secondary wastewater treatment.

The amount of nitrogenous oxygen demand (NOD) associated with different types of wastewater samples obtained from several sources was determined using the standard BOD5 test. The sources included plant samples taken from the three major sewage treatment works in the Chicago area, in addition to samples obtained from various ongoing full-scale nitrification projects. The West-Southwest, North Side and Calumet sewage treatment works are conventional activated sludge, secondary wastewater treatment facilities that discharge unfiltered, chlorinated final effluents. A substantial NOD5 was exerted in both completely nitrified and partially nitrified wastewaters consisting of raw wastewater, primary effluents and final effluents, including those final effluents that were chlorinated. The ammonia-nitrogen contained in the BOD dilution water contributed significantly to the NOD when the residual ammonia-nitrogen in the wastewater samples was low (less than 1 mg/L). Suspended solids removal by filtration considerably reduced the amount of carbonaceous BOD5 measured in the filtered effluents. Removal of nitrifying bacteria by filtration considerably reduced the amount of NOD5 exerted. To consistently operate with an effluent BOD5 of less than 10 mg/liter, sewage treatment works will be required to operate in a mode that will produce effluents with ammonia-nitrogen concentrations of less than 1.0 mg/L, and carbonaceous BOD5 contents of less than 5.0 mg/L. However, the inclusion of filtration at facility would further enhance the ability of the facility to meet the BOD5 standard of 10 mg/L. (Baker-IVI)
W84-02590

A MANAGEMENT APPROACH TO ENERGY COST CONTROL IN WASTEWATER UTILITIES,
Peat, Marwick, Mitchell and Co., Washington, DC.
For primary bibliographic entry see Field 6B.
W84-02592

LEAST COST PROCESS DESIGN FOR GRANULAR ACTIVATED CARBON ADSORBERS,
Zenon Environmental, Inc., Burlington (Ontario).
For primary bibliographic entry see Field 6B.
W84-02593

A NEW DESIGN PROCEDURE FOR WASTE STABILIZATION PONDS,
Technische Univ., Dresden (German D.R.).
D. Uhlmann, F. Recknagel, G. Sandring, S. Schwarz, and G. Eckelmann.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1252-1255, October, 1983. 4 Fig, 1 Tab, 11 Ref.

Descriptors: *Design criteria, *Stabilization ponds, Biochemical oxygen demand, Lagoons, Wastewater treatment, Temperature.

A procedure has been developed that can be used either to calculate the first-order BOD removal coefficient for a given combination of volumetric BOD loading, mean water residence time, and mean temperature for periods greater than 1 month or to find out the optimum combination of mean temperature and number of ponds arranged in series to meet a pretended effluent standard at a given inflowing substrate and water residence time. The equation for the removal coefficient was derived from lab experiments with semicontinuous-flow models of stabilization ponds and covers a broad range of residence times from 4 to 100 days, volumetric BOD loading from 1 to 25 grams/cu m/day, and temperature from 2 to 40 degrees C. The validation of the design procedure was based on the results scaled-up from the laboratory models as compared to the BOD removal measured in large-scale ponds. There was a reasonable degree of correspondence between calculated and actually measured BOD removal. This also applied to the calculation of the performance of stabilization ponds in tropical climates. The method is confined to ponds in series: the removal coefficient has to be calculated for the total pond volume and can then be used to obtain the outflow BOD for the individual ponds within the series. A sensitivity analysis revealed that the change in BOD removal responded to changes in the mean residence time and mean temperature less dramatically than to changes in the inflowing substrate. (Baker-IVI)
W84-02594

ALGAE REMOVAL BY THE OVERLAND FLOW PROCESS,
J. L. Witherow, and B. E. Bledsoe.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1256-1262, October, 1983. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Overland flow, *Algal control, Weed control, Algae, Total suspended solids, Lagoons, Phytoplankton, Secondary wastewater treatment.

Algae removal by the overland flow process was evaluated and the suitability of lagoons for preapplication treatment was determined. The use of facultative lagoons for preapplication treatment for the overland flow process has economic advantages where storage is needed or where more than screens or comminutors are required. The overland flow process has a surface discharge and must meet NPDES secondary treatment limitations to be viable. The process preceeded by a facultative lagoon did not meet the secondary treatment limits for total suspended solids during algal bloom periods when the number of algae are two to three orders of magnitude greater than usual. Both the number and species of plankton in the applied wastewater controlled the ability of the overland flow process to meet these limits. (Baker-IVI)
W84-02595

THE ROLE OF SUSPENDED PARTICLES IN ULTRAVIOLET DISINFECTION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
R. G. Qualls, M. P. Flynn, and J. D. Johnson.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1280-1285, October, 1983. 4 Fig, 4 Tab, 23 Ref. EPA grant R 804770010.

Descriptors: *Disinfection, *Ultraviolet radiation, *Suspended solids, Particulates, Wastewater treatment, Bacteria, Coliforms, Viruses, Filtration, Spectrophotometry.

The effects of absorbed and scattered UV light, and their role in intensity measurement; the effects of exclusion of various particle sizes on the dose-survival curves of coliforms in wastewater; and the effects of mixed-media filtration in a pilot-scale ultraviolet disinfection study were investigated. Suspended particles in wastewater effluents play two roles in UV disinfection: they absorb and scatter the UV light and harbor bacteria that are partially protected from the UV light. Normal spectrophotometric measurements significantly overestimate UV absorbance in wastewater because of scattering. The opalescent plate method of making spectrophotometric UV absorbance measurements gave a close estimate of true absorbance and was not significantly affected by scattering. Disinfection was significantly better in a sand-anthracite filtered effluent than in the unfiltered secondary effluent. Coliforms associated with particles were partially protected from UV disinfection. These protected coliforms were the major factor limiting improved disinfection at -3 or -4 log survival units. (Baker-IVI)
W84-02597

PREDICTING REMOVAL OF TRACE ORGANIC COMPOUNDS BY BIOFILMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. Namkung, R. G. Stratton, and B. E. Rittmann.
Journal of the Water Pollution Control Federation, Vol. 55, No. 11, p 1366-1372, November, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Biofilms, *Organic compounds, *Wastewater treatment, Model studies, Kinetics, Substrates,.

The concept of secondary utilization by biofilms, which allows trace concentrations of organic contaminants to be removed biologically to still lower levels, is evaluated experimentally and theoretically. Five simple organic compounds (acetate, alanine, galactose, thymine, and phenol) were selected as substrates for this biofilm study. The different secondary substrates had different removal profiles when acetate was the primary substrate. Thymine was not readily used as a secondary substrate, and alanine was the most completely removed. The interaction between primary substrate, which maintains the biofilm, and the secondary substrate determines the feasibility of secondary utilization. Each secondary substrate was tested at different feed concentrations. In general, percent substrate

removal increased as the feed concentration was lowered. The effects of concentration changes were most significant for thymine, the least quickly degraded secondary substrate. Modeling secondary utilization by biofilms involves predicting the use of the secondary substrates by the steady-state biofilm; the biomass has already been established by primary substrate utilization. The non-steady-state biofilm model can successfully explain and predict the performance of laboratory scale biofilm reactors for short term secondary utilization if the biofilm thicknesses for the steady state condition are based on primary substrate use and if independently determined kinetic parameters are available for the secondary substrates. (Baker-IVI)
W84-02602

COMPOSITE SAMPLES OVERESTIMATE WASTE LOADS,
Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. J. Schaeffer, H. W. Kerster, D. R. Bauer, K. Rees, and S. McCormick.
Journal of the Water Pollution Control Federation, Vol. 55, No. 11, p 1387-1392, November, 1983. 4 Tab, 13 Ref.

Descriptors: *Sampling, *Composite samples, Waste loads, Estimating, Wastewater treatment facilities, Monitoring.

Composite samples are generally believed to be more representative than grab samples of process stream average performance. If flows and concentrations are uncorrelated and lack autocorrelation, the same applies to the mean concentration of grabs and composites. However, the true variance of flow proportional (FP) composites is larger than that of grab samples or time proportional to flow (TP) composites. Loads computed from FP composites are biased because of the volume weighting of subsamples during FP composting. When flows and concentrations are correlated, then volume proportional to flow (VP) and TP composites produce biased estimates of the mean and variance of concentrations, as well as of loads. The bias arising from the correlation between flow and concentration substantially exceeds that arising from proportioning. As a result, regulatory monitoring data obtained from composite samples must be viewed with suspicion. (Baker-IVI)
W84-02603

DEGRADATION OF CHLOROPHENOLS BY A DEFINED MIXED MICROBIAL COMMUNITY,
Gesamthochschule Wuppertal (Germany, F.R.). Lehrstuhl fuer Chemische Mikrogiologie.
E. Schmidt, M. Hellwig, and H. J. Knackmuss.
Applied and Environmental Microbiology, Vol. 46, No. 5, p 1038-1044, November, 1983. 6 Fig, 13 Ref.

Descriptors: *Chlorophenols, *Microbial degradation, *Biological wastewater treatment, Chlorocatechols, Pseudomonas, Alcaligenes.

Synthetic sewage containing phenol, acetone, and alkanols plus 4-chlorophenol or mixture of isomeric chlorophenols is completely degraded by a defined mixed culture with Pseudomonas sp. strain B13 as a chlorocatechol-dissimilating member of the community. Total degradation of the organic carbon was indicated by release of stoichiometric amounts of chloride and low content of dissolved organic carbon in the cell-free effluents. During adaptation to high loads of chlorophenols the initial meta-cleavage activity was completely replaced by ortho-cleavage activity of type I and II. In the fully acclimated culture, hybrid strains such as Alcaligenes sp. strain A7-2 were detected, which are more competitive than Pseudomonas sp. strain B13 with respect to chlorophenol degradation. (Author's abstract)
W84-02615

WASTEWATER REUSE IN MUSLIM COUNTRIES: AN ISLAMIC PERSPECTIVE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and Z. I. Ansari.
Environmental Management, Vol. 7, No. 2, p 119-123, March, 1983. 3 Ref.

Descriptors: *Water reuse, *Wastewater renovation, *Social aspects, Religious law, Islam, Wastewater treatment.

Recycling wastewater seems to have become a highly useful technique for meeting the shortage of fresh water in all parts of the world. It seems all the more important for Muslim countries because a large number of these countries face acute fresh water shortage. This paper views the problem from an Islamic viewpoint, that is, in the light of the Quran, the Sunnah. and Fiqh works. In Islamic law, water is classified into three categories of tahur, tahir, and mutanajiis. The last two categories can be transmuted into tahur water and thus may be used for all mundane as well as religious purposes if they are assimilated into the overall supply of tahur water. This would be lawful from the Islamic viewpoint even without treating the water. To make use of modern technology in order to recycle wastewater effluents after treatment seems quite in keeping with the spirit and letter of the Islamic teachings. (Author's abstract)
W84-02640

SECONDARY UTILIZATION OF TRACE ORGANICS BY BIOFILMS ON POROUS MEDIA,
California State Water Resources Control Board, Sacramento.
R. G. Stratton, E. Numkung, and B. E. Rittmann.
Journal of the American Water Works Association, Vol. 75, No. 9, p 463-469, September, 1983. 12 Fig, 5 Tab, 25 Ref.

Descriptors: *Organic compounds, *Water treatment, *Biofilms, Secondary utilization, Water reuse, Reclaimed water, Biofilm reactors.

In water reuse schemes as well as in natural biofilm processes are potentially important for the removal of trace levels of organic compounds. The mechanism of secondary utilization in controlled biofilm reactors is described. Secondary utilization is the biodegradation of a secondary substrate. The metabolism of this secondary substrate is inconsequential to sustaining the cells. Trace levels of organics are good examples of secondary substrates. Their concentrations are too low to support any significant cell mass. Experiments with five representative compounds demonstrated that secondary utilization can remove organic compounds from water, even when the input concentrations are low. Experimental and theoretical results showed that fractional removals are often increased as the input concentration is reduced. (Baker-IVI)
W84-02671

BIOLOGICAL TECHNOLOGY OF THE TREATMENT OF LEACHATE FROM SANITARY LANDFILLS,
Australian Atomic Energy Commission, Sutherland. Lucas Heights Research Lab.
P. S. Bull, J. V. Evans, R. M. Wechsler, and K. J. Cleland.
Water Research, Vol. 17, No. 11, p 1473-1481, 1983. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Leachates, *Anaerobic digestion, *Landfills, Biological oxygen demand, Organic carbon, Wastewater treatment, Nitrogen, Free ammonia, Spray irrigation, Wastewater disposal, Lucas Heights Landfill, Sydney, Australia.

Low cost leachate treatment and disposal techniques were investigated for use at the Lucas Heights Regional Landfill Depot, south of Sydney, Australia. The depot covers 55 hectares and accepts waste from commercial, domestic and industrial sources. The total population serviced is 450,000 and approximately 4000 tonnes of waste per week are currently received for disposal. The laboratory-scale treatment was restricted to low cost schemes for treatment of raw leachate to the standard for spray irrigation. The anaerobic biodegradation of pollutants in sanitary landfill leachate is feasible although the process is much slower than its aerobic counterpart. Under the conditions of an average BOD loading (6000 mg/l) and at 4 C, more than 95% of the soluble BOD and essentially all the iron were removed. In addition, over 90% of the nitrogen originally present was converted to free ammonia. The anaerobic processes consumed about 1 mg of phosphorus/g BOD and yielded 100 mg of suspended solids/g BOD consumed. The anaerobic process with phosphate enrichment provided an effluent which had a BOD of 200 mg/l, an iron content of less than 2 mg/l, and a free ammonia content of 700 mg/l, and which is suitable for disposal by spray irrigation or by municipal sewer if available. For discharge to surface waters, ammonia stripping and aerobic polishing is required. The results of the laboratory studies are sufficiently promising to warrant a pilot-scale examination of anaerobic treatment of leachate under field conditions. (Murphy-IVI)
W84-02697

EVALUATION OF A SAMPLER FOR LIQUID EFFLUENTS,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
F. J. Whitby, D. R. Cottrell, D. C.-W. Lau, and E. Bishop.
Water Research, Vol. 17, No. 11, p 1491-1498, 1983. 3 Fig, 7 Tab, 15 Ref.

Descriptors: *Effluents, *Samplers, Automation, Suspended solids, Wastewater, Oil, Organic compounds.

A design of automatic sampler for liquid effluent streams is described, which is based on the use of a rapidly circulating pumped stream of the liquid effluent. This stream passes through an interceptor vessel from which sub-samples may be taken isokinetically to provide a variety of sample types (e.g. snap, composite, flow-related). This interceptor may be conveniently located and may also be used to hold monitoring probes (pH, ion selective electrodes) which will provide continuous information on the composition of the effluent stream. This sampler system has been evaluated using simulated liquid effluents, chosen to represent cases in which it is difficult to acquire a truly representative sample. The cases chosen were: (a) water containing up to 10,000 mg/l of finely divided inorganic solid; (b) water containing 2000 mg/l of sewage solids (c) water containing dissolved, volatile organic solutes; (d) water containing dispersed oil. In all cases it proved practical to obtain samples which were representative in composition of the liquid being tested; comparison in all cases was with snap samples taken simultaneously from appropriate points in the loop system. The sampler appears to be generally suitable for use with most types of liquid effluents. The several components of the sampler should be constructed of materials which are inert to the effluent. (Author's abstract)
W84-02699

THE TREATMENT OF LEACHATES FROM DOMESTIC WASTES IN LANDFILLS-I; AEROBIC BIOLOGICAL TREATMENT OF A MEDIUM-STRENGTH LEACHATE,
Water Research Centre, Stevenage (England).
H. D. Robinson, and P. J. Maris.
Water Research, Vol. 17, No. 11, p 1537-1548, 1983. 7 Fig, 7 Tab, 23 Ref.

Descriptors: *Landfills, *Leachates, *Biological treatment, *Aerobic treatment, Domestic wastes, Temperature effects, Nitrification, Ammonia, Retention time, Chemical oxygen demand, Biochemical oxygen demand.

A medium-strength leachate from domestic solid wastes in a landfill (COD 5000 mg/l, BOD 3000 mg/l) was treated using aerobic biological processes in continuous-flow, laboratory-scale reactors at low temperatures. Each unit was completely mixed, and mixed liquor was wasted such that solids retention time (SRT) was equal to the hydraulic retention period. At 10 C with addition of phosphate (COD:P less than 100:1) SRT values of 10 days were required to obtain well-clarified effluents, and high removal of BOD (>98%) and COD (>92%). Reduction of temperature to 5 C resulted in adverse effects on settling of sludges

from units with SRT values of less than 10 days, but in other units good removal of organic materials could still be obtained. These units operated successfully with concentrations of mixed liquor volatile suspended solids (MLVSS) of 1450 mg/l, equivalent to a ratio of F/M of 0.21 kg BOD/kg MLVSS /day or less. Removal of ammoniacal nitrogen which took place (influent concentration 80 mg/l as N) resulted from incorporation in biomass, and at SRT values of 10 days no nitrification took place at 5 or 10 C. Higher concentrations of ammonia in influent leachates resulted in ammonia in effluents when the ratio of BOD:N was less than about 100:3.6. Increasing the SRT of units to 20 days resulted in erratic conversion to nitrite, but reduced pH-values and possible simultaneous denitrification caused floating sludges and poorly-clarified effluents. Removal of ammonia is identified as a major problem when treating leachates, and further research is recommended. (Author's abstract)
W84-02702

HIGH-RATE OVERLAND FLOW,
Utah Water Research Lab., Logan.
D. Wightman, D. B. George, J. H. Zirschky, and D. S. Filip.
Water Research, Vol. 17, No. 11, p 1679-1690, 1983. 12 Fig, 4 Tab, 21 Ref.

Descriptors: *Overland flow, *Wastewater treatment, Load distribution, Land disposal, Municipal wastewater, Grasses, Nitrogen removal, Phosphorus removal, Biochemical oxygen demand, Suspended solids.

Recommended loading rates for treating raw domestic wastewater by overland flow are 6.3-15 cm/wk. Information provided in the literature yields little insight regarding the upper range of hydraulic loading rates that could be effectively treated by overland flow. Therefore, field investigations were conducted to evaluate the performance of the overland flow system at overland flow rates from 0.95 cu m/day/m width of slope (13 cm/wk) to 4.15 cu m/day/m (57 cm/wk). Preliminary treated municipal wastewater was pumped to overland flow slopes, each approximately 3.7 m wide and 36.5 m long. The slope of each plot was 2.5%. The cover crop consisted of a mixture of ryegrass, bluegrass and fescue grass. The plots were operated for 2 years at six different hydraulic loading rates. Effluent BOD5 concentration averages varied from 6 to 11 mg/l. The reduction of influent BOD5 concentration ranged from 87 to 93%. Mean effluent suspended solids values were from 6 to 9 mg/l with reductions of influent concentrations of 91-95%. Hydraulic application rate had little effect on percent BOD5 or suspended solids removal. Total phosphorus reductions were minimal at all hydraulic application rates due to limited soil water contact. Ammonia concentration in the effluent ranged from 1 mg/l NH3-N at the 0.95 cu m/day/m (13 cm/wk) applied flow rate to 11.7 mg/l NH3-N at the 4.15 cu m/day/m (57 cm/wk) loading rate. Ammonia and nitrogen reductions decreased as the applied flow rate increased. Consequently, lower overland flow rates are necessary for nitrogen removal. The use of high-rate overland flow could potentially reduce the land necessary for this form of land application, if nutrient removal was not a local concern. (Author's abstract)
W84-02714

BACTERIOLOGICAL, VIROLOGICAL AND CHEMICAL EVALUATION OF A WASTEWATER-AQUACULTURE SYSTEM,
Murray State Univ., KY. Dept. of Biological Sciences.
T. W. Hejkal, C. P. Gerba, S. Henderson, and M. Freeze.
Water Research, Vol. 17, No. 12, p 1749-1755, 1983. 3 Fig, 6 Tab, 17 Ref. EPA grant R8054301.

Descriptors: *Aquaculture, *Biological wastewater treatment, *Bacteria, *Viruses, *Heavy metals, Coliforms, Streptococcus, Carp, Sediments, Wastewater treatment, Salmonella, Arkansas.

Levels of fecal coliforms (FC), fecal streptococci (FS), Salmonella spp and enteric viruses were monitored in the water, sediment and fish in experimental wastewater-fish ponds near Benton, Arkansas, U.S.A. Concentrations of five heavy metals were also monitored in the fish and wastewater. Concentrations of indicator bacteria were reduced by as much as 99.7% through the series of six ponds which had a calculated total retention time of 72 days. Two filter-feeding species of Chinese carp, Hypophthalmichthys molitrix (silver carp) and Aristichthys nobilis (bighead carp), grown in the last three ponds accumulated FC and FS in their digestive tracts and skin at levels as great or greater than in the surrounding water and sediment. Only low levels of FC and FS were found in the fish muscle tissue (maximum of 25 FS per 100 g) even when concentrations of bacteria in the gut exceeded 105 per 100 g. Concentrations of bacteria in the water and sediment were not good predictors of concentrations in the fish. No Salmonella and no enteric viruses were isolated from the fish, but this lack of isolates was attributed to the extremely low levels which were present in the influent wastewater. Higher levels of copper and mercury were found in the fish flesh than in the surrounding water, with three of eleven fish samples containing higher than acceptable levels of mercury in the edible portion. Based on the efficiency of wastewater treatment, an aquaculture system using silver and bighead carp was judged to be a viable treatment system for domestic sewage resulting in a product suitable for animal or human consumption if proper precautions are taken in harvesting and processing the fish. (Author's abstract)
W84-02719

COMBINED GAMMA-RAY IRRADIATION-ACTIVATED SLUDGE TREATMENT OF HUMIC ACID SOLUTION FROM LANDFILL LEACHATE,
Tokyo Metropolitan Isotope Research Center (Japan).
M. Yamazaki, T. Sawai, T. Sawai, K. Yamazaki, and S. Kawaguchi.
Water Research, Vol. 17, No. 12, p 1811-1814, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Irradiation, *Landfill leachates, *Activated sludge process, *Gamma-rays, *Humic acids, Leachates, Wastewater treatment, Microbial degradation, Biodegradation.

Humic acid, which is a typical microbially refractory organic substance, was extracted from a landfill leachate. The humic acid solution (COD = 367 mg/l; TOC = 293 mg/l; BOD = 27 mg/l), after the modification of its biodegradability by gamma-ray irradiation, was applied to a batch scale activated sludge treatment. The BOD increased to 64 mg/l by irradiation of 15 kGy (1.5 Mrad), while the COD and TOC decreased to 231 and 230 mg/l, respectively. When the irradiated sample was treated with an activated sludge, the BOD decreased rapidly in 2-3 h to about 15 mg/l which was a similar value as the unirradiated sample was treated. The elimination efficiency of TOC by the sludge treatment was approximately equal to that obtained by irradiation of 15 kGy. These facts suggest a utility of applying microbial processes after radiation treatment of microbially refractory wastewaters. (Author's abstract)
W84-02724

FORMATION OF ORGANIC CHLORINE IN ACTIVATED SLUDGE EFFLUENTS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. K. Koczwara, E. J. Kirsch, and C. P. Leslie Grady, Jr.
Water Research, Vol. 17, No. 12, p 1863-1869, 1983. 1 Fig, 5 Tab, 25 Ref. NSF grant CME-77-12649.

Descriptors: *Chlorination, *Effluents, *Chlorinated hydrocarbons, Activated sludge process, Wastewater treatment, Dissolved oxygen, Breakpoint chlorination, Organic compounds.

Bench scale activated sludge reactors with a solids retention time of 9 days were operated at all combinations of two levels of pH, dissolved oxygen (DO) concentration and feed type (pH 6 and 8; DO 1 and 7 mg/l; simple and complex feed). Long-term composite samples were collected and adjusted to neutral pH and equal concentrations of alkalinity and ammonia nitrogen. They were then breakpoint chlorinated with NaO(36)Cl in order to determine how much chlorine was incorporated into the organic matter. The amounts ranged from 0.019 to 0.067 mg atomic chlorine incorporated per mg soluble organic carbon. Analysis of variance revealed that the DO concentration was the only independent variable to have a significant effect upon the amount of chlorine incorporated, with reactors operated at high DO levels generally producing effluent organics which were less susceptible to adding chlorine. (Author's abstract)
W84-02728

THE REMOVAL OF MERCURY(II) FROM DILUTE AQUEOUS SOLUTION BY ACTIVATED CARBON,
Delaware Univ., Newark. Dept. of Civil Engineering.
C. P. Huang, and D. W. Blankenship.
Water Research, Vol. 18, No. 1, p 37-46, 1984. 12 Fig, 21 Ref. EPA grant R8081401.

Descriptors: *Mercury, *Activated carbon, *Wastewater treatment, Adsorption, Hydrogen ion concentration, Reduction, EDTA.

The results of preliminary screening tests comparing the total Hg(II) removal capacity of 11 different brands of commercial activated carbon indicated that a very high percent (99-100%) total Hg removal was attained by all types of activated carbon especially at pH 4-5; the percent total Hg(II) removal decreased with pH's >< 4-5 except activated carbons Nuchar SA and SN which maintained a relatively high percent (>90%) total Hg(II) removal capacity at all pH values. Experiments were then conducted to reveal the mechanisms of Hg(II) removal by Nuchar SA (a powdered carbon). The results show that total Hg(II) removal was brought by two mechanisms; the adsorption and reduction. In order to investigate the kinetics of these two reactions, volatilization by bubbling N2 gas at high flow rate was used to remove the Hg(g) product of the reduction reaction. It was noted that both the adsorption and the reduction/volatilization reactions were highly pH-dependent; at pH approximately <3-4 or > approximately 9-10 the extent of reduction/volatilization reaction superceded the adsorption reaction; whereas in the mid-pH region adsorption reaction dominated the total Hg(II) removal. The rate of adsorption reaction is very fast, reaching equilibrium in a few minutes; the rate of reduction/volatilization follows a linear square root of t expression. The reduction reaction is more significant with Filtrasorb 400 (H-type carbon) than Nuchar SA (L-type carbon). In the presence of strong chelating agent, ethylenediaminetetraacetate (EDTA), the total Hg(II) removal decreases due partly to the formation of less adsorbably mercuric(II)-EDTA complexes. (Author's abstract)
W84-02739

ELECTRODEPOSITION OF SIX HEAVY METALS ON RETICULATED VITREOUS CARBON ELECTRODE,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Agarwal, A. M. Rochon, H. D. Gesser, and A. B. Sparling.
Water Research, Vol. 18, No. 2, p 227-232, 1984. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Electrodeposition, *Heavy metals, *Reticulated viteous carbon, Electrodes, Industrial wastes, Wastewater treatment, Effluents, Metal-finishing wastes, Copper, Cadmium, Chromium, Lead, Uranium, Zinc.

Metal-bearing liquid effluents resulting from electroplating and other metal processing industrial operations may not be discharged into public sewers as toxic metals interfere with biological treatment systems and restrict the use of biological

sludges. Among the treatment methods available for the removal of these toxic metals at the source, electrodeposition on suitable electrodes is a promising method. Six heavy metals, copper, cadmium, chromium, lead, uranium and zinc were deposited on cathodes made of a newly developed form of carbon, Reticulated Vitreous Carbon (RVC), in a laboratory scale electrochemical reactor. It was possible to electroplate all the six metals from very dilute aqueous using RVC electrodes. Copper deposited 100% at a flow rate of 0.24 cm/min in a single pass while it would require a maximum of 20 passes for 100% chromium deposition at a flow rate of 1.8 cm/min, initial concentrations for both metals being 50 micro mol/l. An increase in flow rate results in a lower percentage of electrodeposition. Experiments conducted using 0.0005 M CuSO4 in 0.5 M Na2SO4 supporting electrolyte resulted in a mass transfer coefficient of the order of 10 to the -3 cm/s and a current efficiency of 64% for the electrodeposition of copper at a cell voltage of 4.0 V. Because of very high porosity, 97%, high specific surface area, up to 66 sq cm/cu cm for RVC grade 100, and useful electrochemical characteristics, RVC can be advantageously used as electrode material for heavy metal removal from dilute industrial effluents. (Moore-IVI)
W84-02750

THE INFLUENCE OF TRANSIENT TEMPERATURE CHANGES ON THE BIODEGRADATION OF NITRILOTRIACETIC ACID IN THE ACTIVATED SLUDGE PROCESS: A PILOT PLANT STUDY,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
T. Stephenson, J. N. Lester, and R. Perry.
Environmental Pollution (Series A), Vol. 32, No. 1, p 1-10, 1983. 2 Fig, 33 Ref.

Descriptors: *Nitrilotriacetic acid, *Activated sludge process, *Biodegradation, Heavy metals, Wastewater treatment, Detergents, Temperature.

Nitrilotriacetic acid (NTA) has been suggested as an alternative detergent builder to sodium tripolyphosphate. NTA used in detergents will reach wastewater treatment plants via the sewerage system. A series of experiments were undertaken using an activated sludge pilot plant treating settled sewage to determine the effects of transient temperature changes on the biodegradation of NTA. The temperature reductions were carried out at two different concentrations of influent heavy metals. Temperature reductions from 17.5 C to 10 C caused a slight decrease in NTA removal. The decrease in NTA removal was more significant during temperature changes from 17.5 C to 7.5 C. Temperature reductions from 17.5 C to 6 C resulted in a substantial decrease in NTA removal. Concentrations of NTA in the effluent attained higher values in experiments with high influent metals concentrations than in comparable experiments with low influent metals concentrations. During cold weather, NTA removal in sewage treatment plants may be impaired, and increased concentrations of NTA in the effluent may be discharged to the receiving waters. (Moore-IVI)
W84-02782

FACTORS AFFECTING THE FATE AND BEHAVIOUR OF TOXIC ELEMENTS IN THE ACTIVATED SLUDGE PROCESS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
S. Kempton, R. M. Sterritt, and J. N. Lester.
Environmental Pollution (Series A), Vol. 32, No. 1, p 51-78, 1983. 11 Fig, 9 Tab, 64 Ref.

Descriptors: *Activated sludge process, *Metals, *Sludge age, Heavy metals, simulation, Wastewater treatment, Effluents, Suspended solids, Chemical oxygen demand, Particulates, Mixed liquor.

Laboratory simulations of the activated sludge process have been used to study the removal efficiencies of toxic elements over a range of sludge ages. Two laboratory-scale activated sludge simulations were supplied with a synthetic sewage, and operated at six sludge ages from 3 to 18 days. Sixteen elements (Ag, As, Bi, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Sn, Tl, V, Zn) were added continuously to one simulation at nominal influent concentrations considered to be typical of an industrial domestic sewage. The second simulation was operated without the addition of toxic elements. The removals of As, Sb, Co, V and Mn were minimal, while those of Ni, Tl, Zn, Cu, Cr and Pb were moderate (up to 50%), and those of Mo, Bi, Cd, Ag and Sn were substantial (50% to 100%). Optimum removals of Cu, Pb and Bi occurred at a sludge age of 12 days, those of Ni and Cr at a sludge age of 9 days and those of Mo and Zn at a sludge age of 6 days. The optimum removal of Cd appeared to occur at a sludge age of 3 days, although an almost equally high removal occurred at a sludge age of 12 days. Mixed liquor and effluent suspended solids and effluent chemical oxygen demand are the primary factors controlling the removal of most toxic elements. The partition of toxic elements appeared to be between the soluble phase and association with particles of greater than 20 micro m in diameter for both effluent and mixed liquor samples. (Moore-IVI)
W84-02783

A PROGRAM TO ELIMINATE INCREMENTAL WATER POLLUTION FROM A MILL EXPANSION,
Mead Corp., Chillicothe, OH.
W. L. Lapp, K. C. Ayers, and J. L. Parr.
Tappi Journal, Vol. 66, No. 12, p 38-41, December, 1983. 1 Fig, 3 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, Michigan, Escanaba River, Lake Michigan, Cooling towers, Clarifiers, Recycling, Settling basins, Wastewater renovation.

Major expansion projects were carried out in mid-May of 1982 so that the Escanaba Mill would have a significantly increased capacity to produce white papers. The expansion included the addition of a giant new paper machine producing 200,000 metric tons/yr of publishing-type papers, a new 272,000 kg/h combination wood-and-coal fired boiler, expanded groundwood pulping facilities and expanded raw water and wastewater treatment facilities. In order to achieve the necessary 10 million gal/day reduction from the existing mill, big loop recycling was chosen. This involves separating the paper machine sewers from the coating and pulp mill sewers. During expansion the wastewater treatment plant was extensively modified and expanded. The two existing primary clarifiers were separated so that one received paper machine effluent and the other received kraft mill and coating effluents. The bleach-plant acid effluent was rerouted to bypass the primary clarifiers. The first aerated settling basin is now used as a surge basin to equalize BOD concentrations and remove a portion of the BOD, producing a more constant BOD loading going to the activated sludge plant. The second basin has been converted to an unaerated stabilization basin to provide effluent polishing prior to discharge. (Baker-IVI)
W84-02914

APPLICATIONS OF REVERSE OSMOSIS TO COMPLEX INDUSTRIAL WASTEWATER TREATMENT,
Manhattan Coll., Bronx, NY. Dept. of Chemical Engineering.
C. S. Slater, R. C. Ahlert, and C. G. Uchrin.
Desalination, Vol. 48, No. 2, p 171-187, October, 1983. 1 Tab, 97 Ref.

Descriptors: *Reverse osmosis, *Industrial wastewater, *Wastewater treatment, Chemical wastewater, Textile wastewater, Electrochemical wastewater, Pulp wastewater, Food industries wastewater, Groundwater pollution, Surface water pollution, Water pollution control.

Methods for treatment of hazardous and complex, aqueous industrial wastes are of great current interest. Reverse osmosis (RO) is an efficient and cost effective process step for renovation of a broad range of complex industrial wastes. The success of RO in large-scale desalination and municipal wastewater treatment has led many industries to view this technology as a means of pollution abatement and cost savings through reuse. Applications include renovation of effluents from the chemical, textile, petrochemical, electrochemical, pulp, paper and food industries. Also, treatment of landfill leachate with RO is showing promise as a means of avoiding groundwater and surface water contamination. (Murphy-IVI)
W84-02930

STABILITY CONSTANTS AND COMPLEXATION CAPACITIES OF COMPLEXES FORMED BETWEEN HEAVY METALS AND EXTRACELLULAR POLYMERS FROM ACTIVATED SLUDGE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
T. Rudd, R. M. Sterritt, and J. N. Lester.
Journal of Chemical Technology and Biotechnology, Vol. 33A, No. 7, p 374-380, October, 1983. 4 Fig, 2 Tab, 33 Ref.

Descriptors: *Activated sludge process, *Heavy metals, *Complexation, *Polymers, Chemical reactions, Wastewater treatment, Stability constants, Copper, Nickel, Cadmium, Cobalt, Fulvic acid.

Conditional stability constants and complexation capacities of extracellular polymers extracted from activated sludge with copper, nickel, cadmium and cobalt have been determined at high and low free metal concentrations using gel complexometry. The purpose of the study was to estimate the contribution of the bacterial extracellular polymer to overall metal removal in the activated sludge process. The conditional stability constants obtained for activated sludge extracellular polymer compare well with those previously determined for extracellular polymer extracted from a capsulated wastewater microorganisms, although the Klebsiella aerogenes polymer exhibited a lower affinity for nickel. The sludge polymer constants appear slightly higher than those for peat fulvic acid, and between three and five orders of magnitude higher than those for fulvic acid extracted from sewage sludge. The complexation capacity of the sludge polymer is comparable with that of other biopolymers. The capacity of the sludge polymer to remove metals during the activated sludge process also depends on its degree of solubility, as metals are only removed if they are settled out with the biomass in the final clarifiers. (Baker-IVI)
W84-02933

5E. Ultimate Disposal Of Wastes

FACTORS AFFECTING THE RELEASE OF TRACE METALS FROM MUNICIPAL SLUDGE ASHES,
Notre Dame Univ., IN. Dept. of Civil Engineering.
T. L. Theis, and L. E. Padgett.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1271-1279, October, 1983. 4 Fig, 9 Tab, 42 Ref. EPA grant R806690.

Descriptors: *Trace metals, *Sludge, *Leaching, *Ashes, Activated sludge processes, Aluminum, Calcium, Iron, Phosphorus, Arsenic, Sludge dewatering.

The physical and chemical properties of a variety of incinerated municipal sludge ashes and the corresponding dewatered sludges were investigated with respect to the release of trace inorganics to aqueous solution. The results of single-reagent and series-extraction tests suggest a model of sludge ash surfaces in an aqueous environment. The surfaces of these ash particles very likely display a mosaic pattern of dominant minerals which also exists with depth into the particles. These minerals dominate the solution chemistry, controlling such factors as pH and major ionic concentrations. Although discreet trace minerals or coprecipitates may exist in the ashes, it is suggested that their solubility in an aqueous environment is controlled by surface bonding primarily to inorganic mineral phases. This bonding is strongly pH-dependent as is typical of such surface. The addition of Fe(III)

and/or Al(III) salts tends to partition metals from organic to inorganic forms in raw sludges. The inorganic fractions of Fe and Al become more crystalline on incineration, which acts to increase the leachability of metal cations (with the exception of Cd) if Fe and Al salts have been added during treatment. If these salts are not added, the leachability of cations decreases as a result of incineration. Arsenic behaved inversely to cationic elements. It was less easily leached from both dewatered sludge and ash in the EPA-EP test when Fe and Al have been added. However, in the IAEA test, where pH is allowed to vary, consistently the greatest total amount of As was removed from sludge ashes. (Baker-IVI)
W84-02596

CHEMICAL COMPOSITION AND POSSIBLE MUTAGENICITY OF MUNICIPAL SLUDGES,
Missouri Univ.-Columbia. Environmental Trace Substances Research Center.
For primary bibliographic entry see Field 5A.
W84-02606

WASTEWATER AND SLUDGE MANAGEMENT IN JAPAN,
C. G. Golueke.
BioCycle, Vol. 24, No. 2, p 44-47, March/April, 1983. 2 Fig, 4 Tab, 7 Ref.

Descriptors: *Sludge disposal, *Land application, Japan, Chemical characteristics, Environmental effects, Water pollution control, Tokyo, Yokohama.

Progress is rapid in Japan concerning improvement of the quality of urban and rural environment and the conservation of the nation's resources, particularly its land and water resources. Ideas presented at a conference on land application of sewage sludge held in Tokyo are presented along with opinions from various Japanese officials and professionals. In 1980 the volume of sewage sludge to be disposed of was estimated to have been 2,400,000 cubic meters. About 2,000,000 cubic meters was in the form of dewatered sludge with 230,000 cubic meters in ash, 16,000 cubic meters as dried and composted sludge, and 180,000 cubic meters as thickened or digested sludge. About 42% of the sludge was landfilled, 36% used in land reclamation, 15% used in agriculture, and 7% incinerated or disposed of in some manner. In spite of the heavy industrialized nature of the Tokyo-Yokohama area, the sludge generated in the area's sewage treatment plants has a relatively low toxic metal concentration. Considerable attention is currently being given to composting of sewage sludge. In the operation of the composting unit, sludge cake (70% moisture) is discharged from a storage tank into a mixing unit, in which sludge cake is crushed and blended with a part of the compost discharged from the composter tank. Mention is made of the public agencies responsible in large part for the impressive progress made in wastewater management and sludge utilization in Japan. (Baker-IVI)
W84-02619

SPRAY IRRIGATION WITH LANDFILL LEACHATE,
Idaho Univ., Sandpoint. Research and Extension Center.
H. A. Menser, W. M. Winant, and O. L. Bennett.
BioCycle, Vol. 24, No. 3, p 22-25, May/June, 1983. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Spray irrigation, *Leachates, *Landfills, Water pollution sources, Water pollution control, Calcium, Sodium, Potassium, Magnesium, Iron, Manganese, Aluminum, Zinc, Strontium, Phosphorus, Copper, Nickel, Lead, Chromium, Cobalt, Cadmium, Metals, Chemical composition, Waste dumps, Wastewater treatment.

A spray irrigation system was used to test the feasibility of decontaminating wastewater by applying sanitary landfill leachate to forest and grass ecosystems. Foliar analysis of the grass species harvested in 1978 revealed no trends toward long-term adverse effects of leachate on the hazardous element constituency of plants. Interim studies showed that Mn levels in most species increased substantially as compared with baseline concentrations. The decline in the loadings of this element and the shift from an acid to a more neutral soil reaction are probably related to a return to low foliar Mn contents. Iron nutrition in these grasses generally has shown trends similar to Mn. Foliar Cl, K, and Na have remained consistently above baseline amounts since the first leachate irrigations. Chloride and Na are relatively mobile ions with low clay attenuation and usually are lost to deep percolation. The persistence of elevated foliar concentrations of these elements suggests that recycled plant residues may contribute to this enhancement. Forage yields have been consistently higher in plots treated in 1974 with superphosphate. Cool-season grasses have shown significantly greater growth in lime and rock phosphate-amended soils as compared with soils that were not fertilized. Bromegrass never became well established and had been eliminated from plots by 1978. Bermudagrasses generally have become well established and grew better with soil amendments. (Baker-IVI)
W84-02620

THE FORMS OF COMBINATION OF CU AND ZN IN DIGESTED SEWAGE SLUDGE,
Oxford Univ. (England). Dept. of Agricultural Science.
A. Baldwin, T. A. Brown, P. H. T. Beckett, and G. E. P. Elliott.
Water Research, Vol. 17, No. 12, p 1935-1944, 1983. 1 Fig, 10 Tab, 35 Ref.

Descriptors: *Sludge, *Copper, *Zinc, Minerals, Plant tissues, Calcium, Iron, Phosphorus, Sulfur, Anaerobic digestion, Hydrogen peroxide.

Digested sewage sludge may be resolved into its principal components by dispersion and sedimentation in water. It contains mineral grains, flakes of micaceous materials, and large and small fragments of plant tissue. Some of these support precipitated compounds of Ca, Fe, P and S. In the samples examined most of these precipitates also contained Cu and Zn. The three samples of sewage sludge produced by the anaerobic digestion of raw primary sludge were collected at different periods. One sample came directly from the digestor, while two were taken from the post-digestion storage tanks. The particles are embedded in a brown matrix comprising fine mineral grains (mainly silica and kaolinite) and microbial detritus, much of which is soluble in acid detergent or in 5M H_2O_2. The matrix is ferruginous and contains inorganic precipitates, including calcium phosphate and possibly a zinc silicate. Chemical analysis and electron microprobe find Cu and Zn in every fraction (except the micaceous material) but they are particularly associated with the components that are destroyed by H_2O_2. (Moore-IVI)
W84-02735

AN ANALYSIS OF REGULATIONS: THEIR IMPACT ON EFFLUENT MANAGEMENT THROUGH PROCESS CONTROL,
National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
For primary bibliographic entry see Field 6E.
W84-02913

5F. Water Treatment and Quality Alteration

USE OF SURFACE WATER FOR REARING CHANNEL CATFISH IN PONDS,
Fish Farming Experimental Station, Stuttgart, AR.
For primary bibliographic entry see Field 6D.
W84-02510

DISINFECTION OF AMOEBIC CYSTS IN WATER WITH FREE CHLORINE,
A. J. Rubin, J. P. Engel, and O. J. Sproul.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1174-1182, September, 1983. 5 Fig, 3 Tab, 38 Ref. EPA grant R-808150.

Descriptors: *Amoebic cysts, *Disinfection, *Chlorination, *Naegleria, Protozoa, Water treatment, Public health, Pathogenic protozoa.

The inactivation of Naegleria gruberi cysts by chlorine was investigated. The non-pathogenic N. grugeri was used because of its close taxonomic relation to N. fowleri and Acanthamoeba, which are major human waterborne pathogenic protozoa. Studies on the rate of inactivation were carried out to determine 99% cyst inactivation at 25 C. Chlorine concentration and pH were measured initially and at convenient intervals. Residuals were also measured. A general pattern of cyst inactivation was noted. At the beginning of the contact period there was a lag during which cyst inactivation was very slow. Following this initial period, the rate of cyst die off increased greatly and the plots of the logarithm of the fraction of cysts surviving against time were essentially linear. At pH 5 the chlorine residuals ranged from 0.45 to 2.64 mg/L-Cl2 with 99% kill times of 15.8 and 2.78 minutes, respectively. Initial chlorine concentrations, measured before adding cysts, were essentially identical to the respective residual concentrations. At pH 7 chlorine residuals ranged from 0.64 to 3.42 mg/L-Cl2 with 99% kill times of 21.5 and 2.9 minutes, respectively. Slightly higher levels of chlorine were needed to effect the same level of inactivation at the higher pH. (Baker-IVI)
W84-02587

SUSCEPTIBILITY OF LEGIONELLA PNEUMOPHILA TO CHLORINE IN TAP WATER,
Pittsburgh Dept. of Water, PA.
J. M. Kuchta, S. J. States, A. M. McNamara, R. M. Wadowsky, and R. B. Yee.
Applied and Environmental Microbiology, Vol. 46, No. 5, p 1134-1139, November, 1983. 3 Fig, 3 Tab, 31 Ref. PHS grant AI 17047.

Descriptors: *Legionella, *Chlorination, *Disinfection, *Coliforms, Water treatment, Public health, Water distribution, Water temperature, Plumbing.

Legionellae in a public water supply system are exposed to chlorine concentrations adjusted to control the presence of the indicator coliform bacteria. A study was conducted to compare the susceptibility of legionellae and coliforms to disinfection by chlorine. The chlorine residuals used were similar to concentrations that might be found in the distribution systems of large public potable water supplies. The effects of various chlorine concentrations, temperatures, and pH levels were considered. A number of different Legionella strains, both environmental and clinical, were tested. Legionellae are much more resistant to chlorine than are coliform bacteria. At 21 C, pH 7.6, and 0.1 mg of free chlorine residual per liter, a 99% kill of L. pneumophila was achieved within 40 min, compared with less than 1 min for Escherichia coli. The observed resistance is enhanced as conditions for disinfection become less optimal. The required contact time for the removal of L. pneumophilia was twice as long at 4 C than it was at 21 C. These data suggests that legionellae can survive low levels of chlorine for relatively long periods of time. This supports the hypothesis that small numbers of legionellae may pass through public water supplies and subsequently contaminate internal plumbing systems. (Moore-IVI)
W84-02617

METHODS FOR TESTING THE EFFICACY OF ULTRAVIOLET LIGHT DISINFECTION DEVICES FOR DRINKING WATER,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. S. Tobin, D. K. Smith, A. Horton, and V. C. Armstrong.
Journal of the American Water Works Association, Vol. 75, No. 9, p 481-484, September, 1983. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Disinfection, *Drinking water, Ultraviolet light, Potable water, Water treatment, Water analysis.

Test protocols were sought that could be used to ensure adequate disinfection under adverse conditions of raw drinking water at the point of use through ultraviolet light devices, particularly in the presence of turbidity and color in the water. The test protocol as developed for fail-safe light sensors uses a color or turbidity agent in the feed solution to reduce the ultraviolet dosage to the established minimum limit in order to determine whether the fail-safe device is properly calibrated and functional. Three commercial UV devices were tested by this method. One device was satisfactory, the second unit was set too low by a factor of 1.6, and the third unit was set low by a factor greater than 2. (Baker-IVI)
W84-02673

REMOVING TRIHALOMETHANE PRECURSORS FROM VARIOUS NATURAL WATERS BY METAL COAGULANTS,
Arizona Univ., Tucson. Dept. of Civil Engineering.
P. A. Chadik, and G. L. Amy.
Journal of the American Water Works Association, Vol. 75, No. 10, p 532-536, October, 1983. 8 Fig, 4 Tab, 18 Ref. NSF grant CHE-8006845.

Descriptors: *Water treatment, *Coagulation, *Natural waters, Trihalomethanes, Alum, Ferric chloride, Chlorides, Organic compounds.

Coagulation of natural waters with alum and ferric chloride proved to be a viable method of trihalomethane control that did not sacrifice effective turbidity removal. The process is particularly attractive for water treatment systems with existing coagulation facilities, precluding large capital expenditures for new processes. The effectiveness of metal coagulation is strongly influenced by process variables, such as coagulant type, coagulant dosage, pH modification, and coagulant aids, as well as raw water characteristics, including TOC, turbidity, alkalinity, ambient pH, and UV absorbance. The bromide ion in natural waters with a trihalomethane formation potential produces brominated trihalomethanes that may greatly contribute to the total trihalomethane formation potential. Brominated haloforms were not reduced by coagulation in the same proportion as chloroform. Caution must be exercised in using TOC and UV absorbance to predict the trihalomethane formation potential of treated and untreated waters. (Baker-IVI)
W84-02675

REMOVING URANIUM FROM DRINKING WATER BY METAL HYDROXIDES AND ANION-EXCHANGE RESIN,
Oak Ridge Operations Office (AEC), TN. Research and Development Div.
S. Y. Lee, and E. A. Bondietti.
Journal of the American Water Works Association, Vol. 75, No. 10, p 536-540, October, 1983. 6 Fig, 2 Tab, 15 Ref. EPA/DOE contract W-7405-eng-26.

Descriptors: *Uranium, *Water treatment, Drinking water, Potable water, Coagulation, Lime, Anion exchange.

Bench-scale testing on uranium removal from a natural water body is described. The water used was chosen as a representative sample of uranium bearing waters. The findings suggest that conventional coagulant and lime softening treatment removes more than 85% of dissolved uranium when an optimum pH and dosage were provided. A strong base anion-exchange column is recommended as an option for the treatment of private well waters containing uranium at higher than desirable levels. The results of small-column experiments suggest that a commercially available column containing 2.2 kg of anion-exchange resin could treat 1,000,000 liters of water containing 83 micrograms U per liter with less than 1 percent breakthrough in the effluent. Anion exchange is available for treating large volumes of water but would require a large capital investment. Small anion exchange columns, however, should be considered for removing uranium from private wells located in uraniferous strata. (Baker-IVI)
W84-02676

COLIFORMS IN A WATER DISTRIBUTION SYSTEM: A REMEDIAL APPROACH,
Springfield City Water, Light and Power, IL. Water Div.
L. D. Hudson, J. W. Hankins, and M. Battaglia.
Journal of the American Water Works Association, Vol. 75, No. 11, p 564-568, November, 1983. 3 Tab, 17 Ref.

Descriptors: *Water distribution, *Coliforms, *Water treatment, Disinfection, Chlorination, Chloramine, Potassium permanganate, Lime, Hydrogen ion concentration, Alkalinity, Bacteria, Residual chlorine, Flushing, Sediments, Springfield, Illinois.

The apparent passage of chloramine-tolerant coliforms through conventional filters and into the distribution system of Springfield, Illinois, in June 1982 signaled the need for intensive control of both the treatment process and the distribution system. The coliform counts exceeded the state bacteriologic standard, resulting in an order to boil water for 10 days even though no coliforms were detected in samples of finished water. Intensive measures were taken to control bacterial growth in the water treatment process and in the distribution system, with an ultimate goal of preventing the reseeding of the system by chlorine-resistant organisms. Chlorine was applied to the incoming raw water in a sufficient dosage to carry a free chlorine residual of approximately 1.0 mg/l through the clarifiers. A 1-mg/l dosage of potassium permanganate was added to the mixing basin. The feed rate of lime was increased to maintain a caustic alkalinity of at least 8.0 mg/l in the clarifiers. The pH of water in the system generally ranged between 10.1 and 10.5. Chlorine was added to the water before it was filtered to obtain a free chlorine residual of 3.0-5.0 mg/l through the clear wells and into the active parts of the system as it was being purged of coliforms. The distribution system was flushed for eight days to blow off sediment and to move the free chlorine residual into the far reaches of the system. Blowoffs were flushed on mains that might accumulate sediment. Laboratory operations were geared to track the success of each operation and to identify the coliform species that had colonized the system. By March 1, 1983, coliforms in the system appeared to be under control, and the counts were within the safe drinking water standards. (Moore-IVI)
W84-02678

RELATIONSHIPS BETWEEN STANDARD PLATE COUNTS AND OTHER PARAMETERS IN WATER DISTRIBUTION SYSTEMS,
FMC Corp., Newark, DE.
M. A. Goshko, H. A. Minnigh, W. O. Pipes, and R. R. Christian.
Journal of the American Water Works Association, Vol. 75, No. 11, p 568-571, November, 1983. 5 Tab, 9 Ref. EPA grant R 805637.

Descriptors: *Water analysis, *Standard plate count, *Coliforms, Turbidity, Residual chlorine, Water temperature, Water distribution, Water treatment, Bacteria, Water quality.

Standard plate counts (SPCs) of water samples collected from seven small, community systems were tested for correlation with coliform occurrence, turbidity, free chlorine residual, total chlorine residual, and temperature. Significant correlations between SPC and one or more of the other parameters were found for some systems. The significant correlations were sometimes positive and sometimes negative, but no generalizations could be made that would fit data for all systems sampled. There was no indication that coliforms or SPC organisms were entering the distribution system through the treatment plant in large densities in any system studied. No single source of contamination was found in any system. Data from an experimental system in which sewage was injected into the treated water showed a strong (alpha <0.01) positive correlation between SPC and coliform densities. From this, it may be inferred that an increase in SPC for a water distribution system may signal a breakdown in sanitary barriers; but, on the other hand, it may be the result of bacterial contamination by some other mechanism. The effects of the sewage introduction were monitored for a longer time with SPC than with coliform counts. The lack of correlation between SPC densities and other water quality parameters should not be taken as an indication that monitoring of SPC is not warranted. Each water quality parameter provides a unique set of information. (Moore-IVI)
W84-02679

THE REMOVAL OF MANGANESE IN WATER TREATMENT CLARIFICATION PROCESSES,
Southern Water Authority, Worthing (England).
A. Lloyd, R. Grzeskowiak, and J. Mendham.
Water Research, Vol. 17, No. 11, p 1517-1523, 1983. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Manganese, *Water treatment, *Clarification, *Floc blanket clarifiers, Adsorption, Oxidation, Calcium carbonate, Chlorination, Iron.

The processes that affect manganese removal in floc blanket clarifiers were studied to assist in the design of manganese removal process. Using the extended Debye-Huckel equation and a hydrogen carbonate acidity correction, an adjusted equation for ionic strength of 0.009 M was developed. This in turn revealed that the rate of oxidation of absorbed manganese must exceed the rate of loss of adsorbed manganese in solids discharged from the floc blanket. If this condition is achieved, then the concentration of manganese oxides in the floc blanket will increase. The rate of loss of adsorbed manganese (II) is calculated from the adsorption ratio on hydrated iron(III) oxide (HIO) and the rate of replacement of HIO in the floc blanket. The removal of manganese from ferruginous ground water is determined mainly by pH, iron and manganese concentration and is relatively insensitive to the variation in composition of other cations or anions. When the solution pH approaches 8.5, calcium carbonate may cause cementing of sand grains in the filter presenting a major problem to treatment plant efficiency. Chlorine can be used to oxidize manganese adsorbed onto HIO and thus overcome the problem of calcium carbonate precipitation. The removal mechanisms may be broadly classified as adsorption and oxidation. (Murphy-IVI)
W84-02701

MUTAGENICITY AND ORGANIC SOLUTE RECOVERY FROM WATER WITH A HIGH-VOLUME RESIN CONCENTRATOR,
Los Angeles County Sanitation Districts, Whittier, CA.
For primary bibliographic entry see Field 5A.
W84-02704

EMPIRICAL RATE EQUATION FOR TRIHALOMETHANE FORMATION WITH CHLORINATION OF HUMIC SUBSTANCES IN WATER,
Yokohama National Univ. (Japan). Dept. of Safety and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W84-02723

MULTIVARIATE STATISTICAL RELATIONSHIPS BETWEEN ROUTINE WATER PLANT DATA AND TRIHALOMETHANE LEVELS; IMPLICATIONS FOR STUDIES OF HUMAN HEALTH,
Ohio State Univ., Columbus. Dept. of Preventive Medicine.
N. A. Reiches, and J. R. Wilkins, III.
Water Research, Vol. 17, No. 12, p 1881-1890, 1983. 3 Fig, 6 Tab, 38 Ref. PHS grant CA21751.

Descriptors: *Trihalomethanes, *Chlorination, *Statistical analysis, Public health, Water treatment, Mathematical models, Water temperature, Color, Chloroform, Chlorinated hydrocarbons, Halogenated hydrocarbons, Estimating, Ohio, Columbus.

Routine water treatment plant data from the Dublin Road Water Plant (Columbus, Ohio) were used to construct a mathematical/statistical model

of trihalomethane formation during lime-soda ash softening. Chemical characteristics of the raw water, such as temperature and color, and several treatment parameters, including chlorine dose, were significant predictors for chloroform and total trihalomethanes. The pattern of prediction was notably different for the brominated species. It appears feasible to model with multivariate statistical methods and routine water plant data the formation of trihalomethanes during the disinfection of water with chlorine. The procedure suggests the prospect of estimating, with reasonable accuracy trihalomethane levels in water supplies for past time periods when only the routine water plant data are available. From a health hazard evaluation perspective, this is a most attractive possibility. (Moore-IVI)
W84-02730

GAS CHROMATOGRAPHY IN WATER ANALYSIS-I; ORGANIC PROFILES OF WATER SOURCES,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
For primary bibliographic entry see Field 5A.
W84-02731

GAS CHROMATOGRAPHY IN WATER ANALYSIS-II; SELECTIVE DETECTION METHODS,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
For primary bibliographic entry see Field 5A.
W84-02732

REMOVAL OF POLIOVIRUS AND ROTAVIRUS FROM TAPWATER BY A QUATERNARY AMMONIUM RESIN,
Arizona Univ., Tucson. Dept. of Microbiology.
C. P. Gerba, G. E. Janauer, and M. Costello.
Water Research, Vol. 18, No. 1, p 17-19, 1984. 4 Tab, 12 Ref.

Descriptors: *Disinfection, *Poliovirus, *Rotavirus, *Anion exchange resins, Water treatment, Viruses, Potable water.

A quaternary ammonium-type anion exchange resin was tested as a contact water viral disinfectant. Suspensions of tapwater containing approximately 10000 plaque-forming units/ml of poliovirus type 1 and Simian rotavirus SA-11 were passed through 1 ml beds of resin, at flow rates of 10-12 ml/min. With resin 14-1, 91->99.9% of the input virus was removed. The beds were effective in removal of virus even after passage of 1500 ml of tapwater. Less than 10% of the virus associated with resin 14-1 could be recovered as compared to 100% for control resin. Kinetic studies indicated that virus adsorbed to the resins were being inactivated. (Author's abstract)
W84-02737

THE DYNAMICS OF SUSPENDED ALGAL POPULATIONS IN THE LOWER WYE CATCHMENT,
Welsh Water Authority, Powys (Wales).
For primary bibliographic entry see Field 2H.
W84-02738

PRELIMINARY STUDIES ON THE LEACHING OF SOME TRACE METALS FROM KITCHEN FAUCETS,
Health and Welfare Canada, Ottawa (Ontario). Environmental Health Centre.
E. R. Samuels, and J. C. Meranger.
Water Research, Vol. 18, No. 1, p 75-80, 1984. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Leaching, *Trace metals, *Faucets, *Plumbing fixtures, *Lead, Cadmium, Copper, Zinc, Chromium, Solder, Fulvic, Heavy metals, Ontario, Ottawa.

Preliminary studies were carried out on the leaching of copper, zinc, chromium, cadmium and lead from eight kitchen faucets by samples of raw, filtered and distributed Ottawa water, a sample of well water and deionized water containing 2 mg/l aqueous fulvic acid. Leaching was effected by allowing the test solutions to stand in the inverted faucets for two successive 24-h periods. Concentrations of the metals found in the leachates were copper; first leaching, 0.12-28.0 mg/l, second leaching, 0.08-3.54 mg/l; zinc; first leaching, 0.13-10.25 mg/l, second leaching, 0.06-2.85 mg/l; chromium; first leaching, <0.001-0.395 mg/l, second leaching, <0.001-0.032 mg/l; cadmium; first leaching, <0.0005-0.01 mg/l, second leaching, <0.0005-0.004 mg/l; and lead; first leaching, <0.2-110.0 mg/l, second leaching, < 0.2-82.0 mg/l. The faucets containing lead-soldered copper joints released high concentrations of lead, particularly in the case of leaching with the aqueous fulvic acid solution. In some cases the concentrations of metals leached could lead to intakes in excess of the maximum permissible limits for these metals. The use of lead solder in kitchen faucets, and conceivably in other parts of the distribution system, could result in abnormally high concentrations of lead in the drinking water, especially if humic substances are present even at low levels. (Moore-IVI)
W84-02740

THE INACTIVATION KINETICS OF H-1 PARVOVIRUS BY CHLORINE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemical Engineering.
C. C. Churn, G. D. Boardman, and R. C. Bates.
Water Research, Vol. 18, No. 2, p 195-203, 1984. 17 Fig, 3 Tab, 17 Ref.

Descriptors: *Parvoviruses, *Chlorination, *Disinfection, *Inactivation kinetics, Virus inactivation, Water treatment.

A newly isolated enteric virus has recently been found to be associated with large outbreaks of waterborne gastroenteritis. Most commonly referred to as the Norwalk agent, this virus appears to be morphologically and biophysically similar to the parvoviruses. In this study the parvovirus H-1, a putative human virus containing single-stranded DNA, was used as a model virus for chlorine inactivation experiments. The objective of this research was to investigate the kinetics of inactivation of this virus by low levels of free chlorine (0.05-0.02 mg/l) at pH 7 and at 5, 10, 20 and 30 C. Inactivation occurred in the usual dose-response relationship, that is, increasing the chlorine dose caused an increase in the rate of inactivation. The energy required for the inactivation reaction using 0.05 mg/l free chlorine from 5 to 30 C was graphically determined to be 2.4 kcal/mol. The change in entropy was calculated to be -52.34 entropy units. For disinfection purposes, the time required for 99% inactivation of H-1 parvovirus at pH 7, 20 C and a chlorine dose of 0.2 mg/l free chlorine was 3.2 min. The parvovirus H-1 appeared to be less resistant to free chlorine than poliovirus type 1 (LSc). (Author's abstract)
W84-02748

UPGRADING WATER FILTRATION PLANTS,
Camp, Dresser and McKee, Inc., Boston, MA.
P. W. Prendiville.
Civil Engineering, Vol. 53, No. 10, p 64-67, October, 1983. 4 Fig.

Descriptors: *Water treatment facilities, *Filtration, Chlorination, Ozone, Chlorine dioxide, Trihalomethanes, Disinfection, Coagulation, Flocculation, Sedimentation.

Improvements are being contemplated by many municipalities for their existing water plants. Plant capacity can often be increased by simply adding or improving mixing, flocculation and sedimentation devices, and changing filter media. Formation of trihalomethanes can be reduced in many cases by changing disinfecting chemical application points or by changing from chlorine to ozone, chlorine dioxide, or chloramines. Hydraulics at a plant can be improved by baffling flow. Coagulant chemicals can be changed or optimized, and laminar tubes or trays can be installed in many existing settling basins. Replacing shallow layers of media with dual media often allows for doubling the capacity of a filter. When media are changed, underdrain and backwashing facilities need to be drained. (Baker-IVI)
W84-02774

A RATIONAL EVALUATION OF CANCER MORTALITY ASSOCIATIONS WITH TREATED DRINKING WATER,
Carollo (John) Engineers, Walnut Creek, CA.
J. E. Tiernan.
Journal of Environmental Health, Vol. 46, No. 3, p 118-126, November/December, 1983. 1 Fig, 1 Tab, 45 Ref.

Descriptors: *Drinking water, *Mortality, *Epidemiology, *Carcinogens, Mutagens, Potable water, Water treatment, Statistical studies.

Identification of known and suspected carcinogens and mutagens in potable water supplies in the United States has led to a series of recent epidemiological investigations. Statistically significant correlations between site-specific and sex-specific cancer mortality rates and treated drinking water have been identified in certain regions of the United States. Some apparently contradictory investigations and criticisms have also received attention. Representative investigations were selected for evaluation utilizing a set of five formalized criteria to determine the probability that an epidemiological association is causal or noncausal. Studies which linked the drinking water variable to increased cancer mortality rates exhibited consistency, statistical strength, dose response relationships, and coherence with existing scientific knowledge. Difficulties in establishing causal relationships were due primarily to temporal associations (duration of dose/length of residence), indirect associations, and specificity of the independent water variable. (Author's abstract)
W84-02799

BACTERIOLOGICAL WATER SAMPLING OF PUBLIC WATER SUPPLY SYSTEMS IN LANCASTER COUNTY, NEBRASKA, 1983,
Lincoln-Lancaster County Health Dept., Lincoln, NE. Div. of Environmental Health.
R. R. Marquart.
Journal of Environmental Health, Vol. 46, No. 3, p 132-135, November/December, 1983. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Sampling, *Drinking water, *Lancaster County, *Nebraska, *Bacteria, Water distribution, Disinfection, Chlorination, Monitoring.

The drinking water monitoring data reported are from public water supply systems in less populated areas of Lancaster County, Nebraska. The field experience from the Lincoln-Lancaster County Health Department and the bacteriological drinking water sampling data from a 6 1/2 year study show that a reduction in flushing time of the sample tap from two minutes to one minute before collecting samples did not increase the number of unsatisfactory samples. The low level of spurious bacteriological water samples (0.49%) during the study indicates that tap disinfection, removing aerators from taps, and lengthy tap flushing time are unnecessary. Reducing the flushing time before collecting samples also results in an annual savings of approximately 22,000 gallons of water in Lancaster County. Unnecessary restrictive procedures in tap selection are time consuming for field staff. Experience in Lancaster County does not support routine removal of the ubiquitous aerator or avoiding taps threaded for hoses as an effective way to prevent unsatisfactory bacteriological water samples. The Health Depatment recommends continuous disinfection for all public water supply systems, and those maintaining adequate free chlorine residuals always had satisfactory bacteriological water samples. (Moore-IVI)
W84-02800

SIGNIFICANCE OF LOSSES IN WATER DISTRIBUTION SYSTEMS IN INDIA,

National Environmental Engineering Research Inst., Nagpur (India). Environmental Engineering Consultancy Div.
V. Raman.
Bulletin of the World Health Organization, Vol. 61, No. 5, p 867-870, 1983. 3 Tab.

Descriptors: *Water distribution, *India, *Leakage, *Water loss, Water conservation, Cost-benefit analysis, Pipes, Water conveyance.

Effective management of water supply systems consists in supplying adequate quantities of clean water to the population. Detailed pilot studies of water distribution systems were carried out in 9 cities in India during 1971-81 to establish the feasibility of a program of assessment, detection, and control of water losses from supply systems. A cost-benefit analysis was carried out. Water losses from mains and service pipes in the areas studied amounted to 20-35% of the total flow in the system. At a conservative estimate, the national loss of processed water through leaks in the water distribution systems amounts to 1012 liters per year, which is equivalent to 500 million rupees. It is possible to bring down the water losses in the pipe mains to 3-5% of the total flow, and the cost incurred on the control program can be recovered in 6-18 months. Appropriate conservation measures will help in achieving the goals of the International Water Supply and Sanitation Decade to provide clean water for all. (Author's abstract)
W84-02801

AN ESTIMATION OF THE EXPOSURE OF THE POPULATION IN FINLAND TO SUSPECTED CHEMICAL CARCINOGENS,
Institute of Occupational Health, Helsinki (Finland).
K. Hemminki, H. Vainio, M. Sorsa, and S. Salminen.
Journal of Environmental Science and Health, Vol. C1, No. 1, p 55-95, 1983. 6 Tab, 124 Ref.

Descriptors: *Drinking water, *Water quality, *Public health, *Carcinogens, *Finland, Asbestos, Polycyclic aromatic hydrocarbons, Trihalomethanes, Chloroform, Chlorination, Decomposing organic matter.

Information available from Finland was used to estimate the total exposure of the population to compounds suspected of carcinogenicity. Potable water was found to account for daily exposures of less than 1 mg. In Finland the most frequently used source of raw water is surface water. Surface water contains much organic material, most of it naturally occurring humus. Extensive purification and treatment processes are required to guarantee the quality of drinking water. The concentration of some natural compounds and reaction products may reach a level where toxic effects are possible. About 2 million Finns use drinking water with an approximate mean trihalomethane concentration of 0.07 mg/l. The highest concentration found was 1.3 mg/l, due partly to the naturally occurring aquatic humus and eutrophication in Finnish raw waters, and partly to the break-point chlorination practice. In most Finnish studies the sum of the concentrations of polycyclic aromatic hydrocarbons analyzed has been below 200 ng/l, the maximum allowable concentration for these compounds in drinking water. Assuming a 2 liter per capita consumption of drinking water per day, the approximate mean amount of PAHs taken in by the average Finn may be around 0.2 micrograms/day. Since the pipeline material formerly used in Finland has a high content of asbestos, which may dissolve in the drinking water, it is likely that the drinking water contains some asbestos fibers. (Baker-IVI)
W84-02822

THE RISKS OF DRINKING WATER,
Harvard Univ., Cambridge, MA. Energy and Environmental Policy Center.
E. A. C. Crouch, R. Wilson, and L. Zeise.
Water Resources Research, Vol. 19, No. 6, p 1359-1375, December, 1983. 2 Fig, 2 Tab, 50 Ref.

Descriptors: *Carcinogens, *Drinking water, *Public health, Organic compounds, Water pollution effects, Water quality standards.

Current drinking water standards are not directly related to health risks posed. Usually it is cancer risk which is of greatest concern in the setting of guidelines for low levels of organic compounds, and almost always estimates of cancer risk are made in an atmosphere of uncertainty. Current standards for a given chemical or class of chemicals do not account for the present of other pollutants, chemicals which have not been tested in long term oral bioassays are generally ignored, and the uncertainties of risk calculations are not explicitly considered. To better quantify risks from drinking waters, procedures are applied which incorporate measures of uncertainty into the risk calculation and consider all chemicals included in a water analysis. This procedure is demonstrated by calculating risks for 25 U.S. water supplies, based on the EPA National Organic Monitoring Survey of 1976-77. All the cities had average risks greater than 10 to the -6th per year and several had values of 10 to the -5th and above. (Moore-IVI)
W84-02839

COMBINED APPLICATION OF OZONE AND CHLORINE OR CHLORAMINE TO REDUCE PRODUCTION OF CHLORINATED ORGANICS IN DRINKING WATER DISINFECTION,
Beak Consultants Ltd., Mississauga (Ontario).
J. L. Robertson, and A. Oda.
Ozone: Science and Engineering, Vol. 5, No. 2, p 79-93, 1983. 4 Fig, 9 Tab, 16 Ref.

Descriptors: *Ozone, *Chlorine, *Chloramine, *Residual chlorine, *Organic solvents, *Drinking water, *Disinfection, Ozonation, Chlorination, Water quality, Water quality control.

Chlorination of water produces halogenated organics in addition to trihalomethanes. Ozone is examined as the primary disinfectant on water supplies in Ontario containing high concentrations of dissolved organic carbon (DOC), as a means to reduce elevated levels of trihalomethanes (THM). Previous work had indicated that elimination of pre-chlorination leads to reduced THM concentrations. However, the elimination of primary disinfection may lead to problems of bacterial and algal growth as well as to taste and odor problems in water treatment plants with high DOC raw water supplies. Pilot plant studies demonstrated that pre-ozonation coupled with controlled use of post-chlorination led to significant reductions in both THM and non-purgeable organo-halogen (NPOX) compounds. The use of chloramine to provide a residual following pre-ozonation virtually eliminated the formation of THM and NPOX. Batch tests confirmed these conclusions for another high DOC water supply, although the THM and NPOX production per unit of DOC varied between water supplies. The results have significant practical implications for the control of THM and NPOX in drinking water disinfection. (Murphy-IVI)
W84-02905

USE OF OZONE IN THE TECHNOLOGY OF BOTTLED WATER,
Institut Fresenius, Taunusstein (Germany F. R.).
W. Schneider, and H. H. Rump.
Ozone: Science and Engineering, Vol. 5, No. 2, p 95-101, 1983. 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Ozone, *Bottled water, Mineral water, Ozonation, Chemical properties, Sulfur, Iron, Manganese, Arsenic, Alumina, Filtration, Water quality standards, Sterilization.

A review is given on the EC requirements for mineral water and on the analytical examinations necessary for proving its natural purity. Ozone treatment in combination with filtration can remove several undesirable substances without any major alteration of the chemical composition. Such substances would otherwise impede the marketability of a water. Sulfur, iron and manganese are easily oxidized by ozone and the iron and manganese hydroxides are removed by filtration. Arsenic is eliminated by coprecipitation with iron. Fluoride can be largely removed by filtration through alumina. Any off-taste, occasionally caused by natural organic substances, is prevented by the ozone treatment. Additionally, there is the possibility of sterilizing wine bottles with ozone-containing water. (Murphy-IVI)
W84-02906

IMPROVING FILTER MEDIA (ACTIVATED CARBON) BY OXIDATIVE PRETREATMENT WITH OZONE AND PERSULPHATE,
Ecole Nationale Superieure de Chimie de Rennes (France).
K. Gaid, D. Lemarchand, G. Martin, and C. Cavelier.
Ozone: Science and Engineering, Vol. 5, No. 2, p 113-127, 1983. 13 Fig, 6 Tab, 17 Ref.

Descriptors: *Filter media, *Activated carbon, *Pretreatment of water, *Ozone, *Persulfate, Drinking water, Physical properties, Chemical properties, Water pollution control, Porous media.

Treatment of drinking water with activated carbon by oxidation of the carbon altering its physical and chemical properties improves the quality of the water Ozonized carbons are more efficient than non-treated carbons both in physical-chemical and biological treatment. Oxidation is realized by means of two oxidants: ozone or ammonium persulfate. The treatment modifies the distribution of porous volume of carbon, creates surface conditions which appears to affect the rate, the capacity and character of pollutant elimination. Oxidation favors the retention of adsorbable and non-adsorbable compounds (humic substances, phenols, ethanol). (Murphy-IVI)
W84-02907

EXPERIENCES WITH COAGULATIONS AND COAGULANTS,
Dallas City Water Utilities Dept., TX.
R. F. Stone.
Southwest and Texas Water Works Journal, Vol. 65, No. 9, p 17-20, 1983.

Descriptors: *Coagulation, *Water treatment, *Coagulants, Drinking water, Texas, Dallas, Lime, Ferric sulfate, Clarification, Polymers, Turbidity.

Several lake sources provide the raw water for use in the Dallas drinking water supply. Experience there with coagulation has mostly been with ferric sulfate in conjunction with lime softening. While this treatment mode produces a high quality of water under essentially all conditions, it also produces a high quantity of sludge by-product. Prior to 1966 total lime softening had been employed. After 1966 a partial softening was recommended by feeding only sufficient lime to produce a finished water with a total alkalinity of 50 ppm. With the reduction in lime feed, the ferric sulfate coagulation was somewhat less efficient and a higher coagulant dosage was required to properly clarify the water before filtration. The major problem with the partial softening process was in being able to clarify high turbidity storm water runoff which came down the river after heavy rainfalls. Large quantities of waste sludge are produced in this method. Experiments are being conducted using polymers as coagulants. (Baker-IVI)
W84-02910

WATER SUPPLY AND TREATMENT: WHAT MODERN TECHNOLOGY HAS TO OFFER,
G. L. Ingham.
Water and Waste Treatment, Vol. 26, No. 11, p 30-32, November, 1983. 1 Fig.

Descriptors: *Technology, *Water treatment, Economic aspects, Telemetry, Computers, Management, Decision making, Planning.

Various parameters may encourage a manager of a water supply and treatment facility to consider and implement the introduction of new and more sophisticated equipment. Increased efficiency, reductions in manpower, improved reliability, additional management information, lower capital costs, and

reduced waste are some of the parameters which will encourage the use of more modern technology. The two major questions which must be answered involve cost - how much will the changes cost to achieve, and what will be the initial and long-term savings of the project. Considerable pressure will be experienced by those facing the task of making decisions, as the field of manufacture and supply of technological equipment is extremely competitive. An example of one phase of modern technology is offered in the form of a comprehensive telemetry system which has been used to replace a very old-fashioned system of monitoring the water treatment and supply system of a company. (Baker-IVI)
W84-02916

5G. Water Quality Control

BIOLOGICAL CONTROL OF UNDESIRABLE CYANOBACTERIA IN CULTURALLY EUTROPHIC LAKES,
Oslo Univ. (Norway). Zoological Museum.
A. Brabrand, B. A. Faafeng, T. Kallqvist, and J. P. Nilssen.
Oecologia, Vol. 60, No. 1, p 1-5, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Oscillatoria, *Nassula, *Biological control, *Eutrophication, Cyanophyta, Nuisance algae, Roach, Cyclops, Model studies, Water temperature, Eutrophic lakes.

The relationship between Oscillatoria agardhii and one of its natural grazers, the gymnostomid ciliate Nassula ornata was studied in laboratory experiments. Ingestion of Oscillatoria by Nassula increased exponentially over the temperature range 5-20 C, and the grazer was able to suppress Oscillatoria at all temperatures. Laboratory studies showed further that the predatory copepod Cyclops strenuus was able to suppress Nassula, and that juvenile roach (Rutilus rutilus) also fed on Nassula. In an enclosure experiment in an Oscillatoria-lake, Nassula reduced Oscillatoria concentration more that 50% as compared to the control. The scarcity of Nassula in many Oscillatoria-lakes may be due to predation by cyclopod copepods and juvenile fish; predominantly cyprinids. A proposed model describes well the population dynamics of Oscillatoria and Nassula in mixed cultures. Predation by crustaceans hampers the prospect of employing Nassula in the biological control of Oscillatoria. However, an introduction of Nassula in sufficient numbers to Oscillatoria-lakes at a time when the population of activity of potential predators is low should be seriously considered as a measure to reduce Oscillatoria blooms. (Moore-IVI)
W84-02493

PHOSPHORUS CONTROL MEASURES PAY OFF IN THE GREAT LAKES,
Michigan Dept. of Natural Resources, Lansing.
J. H. Hartig.
Water Engineering and Management, p 32-35, December, 1983. 5 Fig, 10 Ref.

Descriptors: *Phosphorus, *Great Lakes, *Water quality control, Wastewater treatment, Sludge treatment, Secondary wastewater treatment, Wastewater treatment facilities, Detroit River, Lake Erie, Ontario, Water pollution control, Phosphorus removal, Phytoplankton.

The levels of phosphorus detected in the Detroit River as it moves into Lake Erie have declines by 85% since 1967, most of which is due to phosphorus control efforts made at the Detroit Wastewater Treatment Plant. This 2.5 mgd plant is the largest facility of its kind in the Great Lakes Basin discharging to the Great Lakes, serving over 3 million people. The plant provides activated sludge, secondary treatment to the dry-weather flows of 76 communities. The treatment process includes preliminary treatment, primary treatment incorporating chemical feed for phosphorus removal and sedimentation, activated-sludge secondary treatment, chlorination, and sludge treatment and disposal. A decline in phosphorus concentrations was also noted in the Western Basin, measured at the Union Water Intake in Kingsville, Ontario. This decrease has been about 50% since 1967 and appears to have been the result of a major decline in the North Shore net phytoplankton community. Open lake phytoplankton analyses have also indicated a reduction of total phytoplankton biomass and a shift in species composition toward oligotrophy. (Baker-IVI)
W84-02520

STATISTICAL MODELS FOR WATER QUALITY REGULATION,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
J. C. Loftis, R. C. Ward, and G. M. Smillie.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1098-1104, August, 1983. 1 Tab, 8 Ref. NSF grant PRA-7913073.

Descriptors: *Statistical models, *Water quality control, Water quality, Model studies, Mathematical studies, Probability distribution, Frequency distribution, Stationary process, Seasonal variations, Linear programming, Confidence intervals.

A few statistical methods, simple enough for immediate use by regulatory agencies, are summarized and demonstrated for use in interpreting water quality data in light of current stream standards. The specific statistical techniques include: unconditional probability distribution models, seasonal probability distribution models, linear regression models, and confidence intervals on probability models. The usefulness of models such as the linear regression models lies in their ability to distinguish between natural and artificial causal mechanisms governing water quality processes. All four of the methods may be used by regulatory agencies in an effort to evaluate the significance of water quality changes, particularly standards violations, with regard to the relative importance of natural impacts or artificial impacts on water quality. The choice of which to apply will depend on the individual situation. Each of the four can be applied by personnel with only a limited understanding of statistical theory and only small microcomputers or programmable calculators and needed to perform the required computations on a routine basis. Application of these methods and tools should greatly enhance the ability of routine, fixed-station monitoring to provide in an efficient manner the kind of information needed for implementing the Clean Water Act. (Baker-IVI)
W84-02577

MANAGEMENT OF A GROUNDWATER PROBLEM,
Stollar (Robert L.) and Associates, Cypress, CA.
R. L. Stollar, R. Pellissier, and P. Studebaker.
Journal of the Water Pollution Control Federation, Vol. 55, No. 11, p 1393-1403, November, 1983. 11 Fig, 9 Ref.

Descriptors: *Groundwater pollution, *Water quality control, Resistivity, Plumes, Water pollution sources, Groundwater movement, Phosphates.

The use of resistivity studies and drilling programs facilitated detailed description of the hydrogeologic environment and the geometry of a contaminated groundwater body. A monitoring program was designed and initiated after the drilling program was completed. Interpretation of the data collected during the monitoring program was successfully used to interpret the dynamics of the groundwater system, impacts of pumping, and migration of contaminants within the groundwater system. The results of the field and monitoring program enabled groundwater management, abatement, and control progams to be designed and initiated. It seems that these new programs will control the plume underlying the FMC Corporation Industrial Chemical Group plant and manage the groundwater problem in Lawrence, Kansas. (Baker-IVI)
W84-02604

DIURNAL WATER QUALITY MODELING - A CASE STUDY,
Weston (Roy F.), Inc., West Chester, PA.
A. K. Deb, and D. Bowers.
Journal of the Water Pollution Control Federation, Vol. 55, No. 12, p 1476-1488, December, 1983. 15 Fig, 3 Tab, 4 Ref.

Descriptors: *Water quality control, *Model studies, Dissolved oxygen, Wastewater treatment facilities, Water treatment, Shenandoah River.

Requirements for treatment beyond secondary levels of publicly owned treatment works (POTWs) must now be supported by a calibrated and verified water quality modeling study. In many small streams, diurnal dissolved oxygen fluctuations from photosynthesis are so large that proper mathematical simulation of diurnal variation in the stream is needed. A systematic, rational method has been used to simulate the diurnal changes in DO concentration of a stream. The South Fork of the Shenandoah River has been modelled. Three sets of comprehensive stream surveys were conducted. The DIURNAL model was used to simulate the diurnal behavior of the stream DO. Proper simulation of diurnal DO fluctuations depends largely on the proper evaluation of photosynthetic and respiration rates of aquatic plant communities. After proper calibration and model verification, a rational methodology of wasteload allocation was used to develop various combinations of permissible carbonaceous BOD and nitrogenous BOD wasteloads to meet water quality criteria. The methodology of diurnal DO modelling and wasteload allocation discussed will help practical engineers develop wasteload allocations for streams with high diurnal DO fluctuations. (Baker-IVI)
W84-02607

VARIABLE EFFLUENT NITRIFICATION REQUIREMENTS BASED ON INSTREAM WATER QUALITY,
Black and Veatch, Denver, CO.
R. D. Kuchenrither, C. P. Houck, C. W. Inghram, M. M. Grimes, and G. K. Elmund.
Journal of the Water Pollution Control Federation, Vol. 55, No. 12, p 1489-1496, December, 1983. 5 Fig, 4 Tab.

Descriptors: *Water quality control, *Nitrification, *Effluents, Effluent standards, Fort Collins, Colorado, Ammonia, Nitrogen.

Fort Collins, Colorado, has two wastewater treatment plants that discharge to the Poudre River. Plant 1 has no nitrification requirements and is base-loaded at an annual average rate of 175L/s in the winter and 263L/s in the summer. Plant 2 is located between two major irrigation water diversion ditches, Fossil Creek Ditch and Boxelder Ditch. Plant 2 has an effluent total ammonia nitrogen discharge limit of 4.9 mg/L in summer and winter. To meet this limit, wastewaters must undergo nitrification prior to discharge to the river. The city has demonstrated that a water quality management program consisting of daily manipulation of discharge points represents a viable alternative to nitrification at its wastewater treatment facilities. Under the existing discharge permit, nitrification was required for each of the 680 days analyzed. However, the analysis of actual stream data showed that only on 4 of these 680 days would nitrification have been required to avoid exceeding the 0.10, g/L ammonia-nitrogen limitation in the Poudre River. The program as proposed has the potential to save the citizens of Fort Collins a minimum of about $140,000 annually, and at the same time, to maintain higher flows and assure the protection of the water quality in the river. Under a static discharge permit process currently employed, the simultaneous accomplishment of these three objectives is not impossible. (Baker-IVI)
W84-02608

NONPOINT SOURCE WATER POLLUTION ABATEMENT AND THE FEASIBILITY OF VOLUNTARY PROGRAMS,

Wisconsin Univ.-Milwaukee. Dept. of Urban Planning.
D. S. Sawicki, and L. B. Judd.
Environmental Management, Vol. 7, No. 5, p 453-464, 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Voluntary programs, Decentralization, Institutional constraints, Urban areas, Rural areas, Root River watershed, Illinois.

A voluntary, decentralized institutional arrangement for nonpoint source water pollution control used in the Root River watershed in southeastern Wisconsin was studied in order to monitor and draw conclusions about the effectiveness of a voluntary, decentralized institutional system, to specify deficiencies of the approach and suggest means to correct them, and to use the conclusions to speculate about the need for regulations regarding nonpoint source pollution control or the appropriateness of financial incentives for nonpoint source control. This watershed was chosen because of its mix of urban, agricultural, and urbanizing land uses. Institutional factors considered include diversity of land uses in the watershed, educational needs, economic conditions, personality, water quality, number of agencies involved, definition of authority, and bureaucratic requirements. Fairly good progress was made toward securing cooperative agreements with landowners and committing cost share funds to implement rural nonpoint source control practices. There was little evidence that the institutional system used will result in implementation of urban runoff control practices. The decentralization used in the Root River watershed is responsible both for its degree of success and for many of the impediments to greater progress. The voluntary approach has been well received in the watershed and has been successful in committing cost-sharing money to soil-related (rural) practices. It has not resulted in committment to practices in the priority established in the plan and offers little control over the order in which practices are implemented. Decentralization does not offer as great an advantage for urban practices, and it may have hindered progress in the Root River watershed. (Moore-IVI)
W84-02643

PATTERNS IN GROUNDWATER QUALITY: SELECTED OBSERVATIONS IN IOWA,
Iowa Univ., Iowa City. Dept. of Geology.
R. Rajagopal, and R. L. Talcott.
Environmental Management, Vol. 7, No. 5, p 465-474, 1983. 6 Fig, 5 Tab, 18 Ref.

Descriptors: *Water quality, *Groundwater, *Iowa, Nitrates, Sulfates, Carbonates, Well water, Seasonal variation, Groundwater pollution, Runoff.

Groundwater quality in Iowa varies with depth, location, ownership of well, time of sampling, and geologic features. Samples from deep wells (>30.48 m or 100 ft) are highly mineralized with sulfates and carbonates (calcium and magnesium), whereas the mineral content in samples from shallow wells (<30.48 m or 100 ft) is relatively much lower. Nitrate as a percent of dissolved solids is negligible in samples from deep wells and reaches as high as 3 to 5% in samples from shallow wells. Shallow wells, in particular nonpublic wells, are highly susceptible to nitrate contamination (with an average concentration of 27.8 mg/l) compared with any other category of wells studied. In shallow non-public wells, the concentration of nitrate from recent geologic deposits (31.61 mg/l) is more than twice the level found in corresponding public wells from similar deposits (13.35 mg/l). Shallow non-public wells are also subject to sharp seasonal fluctuations, with a peak nitrate concentration of 55.81 mg/l in the month of May, possibly because of spring runoff from agricultural and other surface sources. These observations are further supported by the results of nitrate analyses from a large number (over 44,000) of private wells in Iowa. Eighteen percent of these private wells were found to exceed the maximum contaminant level of 45 mg/l nitrate, NO3(-). A higher proportion of the shallow wells (<30.48 m or 100 ft) exceed the maximum contaminant level of 45 mg/l (3867 out of 13,625 or 28.4%). It is proposed that the observed variability in groundwater quality be used as a first step in developing a strategy for strengthening state-wide groundwater quality monitoring programs. Strong state-wide programs would be of considerable assistance to policy makers in the resolution of major groundwater quality issues. (Author's abstract)
W84-02644

SECONDARY UTILIZATION OF TRACE ORGANICS BY BIOFILMS ON POROUS MEDIA,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5D.
W84-02671

ACID RAIN DEBATE MAY PLAY A ROLE IN THE 1984 PRESIDENTIAL SWEEPSTAKES,
L. Mosher.
National Journal, Vol. 15, No. 20, p 998-999, May 14, 1983.

Descriptors: *Acid rain, *Legislation, Decision making, Planning, Management, Water quality control, Sulfur, Powerplants, Scrubbers.

A plan has been advanced to create an acid rain superfund by levying a tax of 0.3 cents per kilowatt hour on all users of electricity generated from fossil fuel-powered plants in 31 states that either border on or lie east of the Mississippi River. This fund would be used to help power plants pay for installing costly pollution control equipment such as scrubbers that remove sulfur from plant exhaust fumes. Other proposals for dealing with the acid rain problem are also briefly presented including the Mitchell-Stafford bills. Industry reaction to these various alternatives for dealing with the problem is outlined. (Baker-IVI)
W84-02696

BIOLOGICAL TECHNOLOGY OF THE TREATMENT OF LEACHATE FROM SANITARY LANDFILLS,
Australian Atomic Energy Commission, Sutherland. Lucas Heights Research Lab.
For primary bibliographic entry see Field 5D.
W84-02697

HYPOLIMNETIC AERATION AND DISSOLVED GAS CONCENTRATIONS; ENCLOSURE EXPERIMENTS,
York Univ., Downsview (Ontario). Dept. of Biology.
D. J. McQueen, and D. R. S. Lean.
Water Research, Vol. 17, No. 12, p 1781-1790, 1983. 10 Fig, 2 Tab, 48 Ref.

Descriptors: *Hypolimnion, *Aeration, *Dissolved gases, Mud-water interfaces, Nutrients, Dissolved oxygen, Methane, Hydrogen sulfide.

Two large circular enclosures, each containing approximately 550 cu m of water, 14 m deep, and open to the mud-water interface, were used to monitor the effects of hypolimnetic aeration. One enclosure was held as a control, the other aerated every 3 or 4 days for a period long enough (usually < 2h) to maintain hypolimnetic O2 levels at > 4 mg/l. Nutrient additions (10 g of 90% H3PO4 and 250 g NaNO3 per week) to each enclosure were controlled from the commencement of the experiment (17 June 1980) until its completion (2 November 1981). Temperatures in both enclosures were identical. Hypolimnetic O2 levels in the control fell to zero during both summers, but remained at >4 mg/l in the aerated enclosure. Free N2 concentrations in the hypolimnion of the aerated enclosure was higher than in the control. Concentrations of H2S in the control hypolimnion increased to >5 mg/l and concentrations of CH4 increased to > 18 mg/l. Both remained at or near zero in the aerated enclosure. Tests of aerator efficiency suggested that the full air-lift design that was employed had an average O2 exchange efficiency of 42% which is higher than the values reported for most other designs. (Author's abstract)
W84-02721

CONTROL OF DO LEVEL IN A RIVER UNDER UNCERTAINTY,
California Univ., Berkeley. Dept. of Biomedical and Environmental Health Sciences.
R. C. Spear, and G. M. Hornberger.
Water Resources Research, Vol. 19, No. 5, p 1266-1270, October, 1983. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Dissolved oxygen, *Mathematical models, *Water pollution control, Water quality, Simulation, Wastewater lagoons, Effluents, Rivers, Algae, Photosynthesis.

A regionalized sensitivity analysis for exposing critical uncertainties in models of environmental systems is extended to study control of systems for which there is a good deal of uncertainty in the mathematical model used to describe the appropriate physical, chemical, and biological processes. The method is based on a binary classification of Monte Carlo simulation results as being either satisfactory or unsatisfactory in terms of controller performance. Contrasts in parameters associated with the two classes are elucidated by statistical analysis. This allows the selection of a set of control parameters that maximizes the probability of acceptable behavior in the presence of uncertainty in process parameters. The method is applied to the problem of regulating the discharge from a lagoon with the object of preventing dissolved oyxgen (DO) from falling below a predetermined standard. Releases from the lagoon to the river are to be scheduled such that dissolved oxygen in the river is not driven below a specified water quality standard and such that the lagoon does not overflow nor fall below some minimum level. For this system the desired behavior of the controlled process can be achieved with a probability of 0.84 with a particularly simple controller design. If this probability were deemed insufficient, three courses of action are open: enlarge the lagoon, narrow the process parameter uncertainty, or investigate other controller structures. Two of the parameters associated with algal photosynthesis were critical to the controler's ability to maintain acceptable DO levels. Even modest levels of uncertainty in the process parameters can have a considerable effect on the controller performance and additional attention should be devoted to the design of robust controllers for environmental systems. (Moore-IVI)
W84-02767

EVALUATION OF SURFACE IMPOUNDMENT ASSESSMENT IN NEW MEXICO,
Geological Survey, Reston, VA.
M. Person, R. Antle, and D. B. Stephens.
Ground Water, Vol. 21, No. 6, p 679-688, November-December, 1983. 10 Fig, 2 Tab, 15 Ref.

Descriptors: *Groundwater pollution, *Surface impoundment assessment, *Waste disposal, Pits, Ponds, Groundwater management, Lagoons, Groundwater quality, Vadose water, Waste dumps, New Mexico.

Surface Impoundment Assessment (SIA) is a method for determining the potential for groundwater contamination from pits, ponds and lagoons. SIA produces a numerical rating of a site, based on the sum of scores assigned to four categories: vadose zone properties, groundwater availability, groundwater quality, and waste characteristics. The SIA for New Mexico was conducted as part of a nationwide survey of potentially hazardous waste disposal sites. The SIA showed a reasonably good agreement between predicted high potential for groundwater contamination and observed or suspected contamination. The Mann-Whitney U-Test and the stepwise logistic regression method for statistically evaluating the SIA results for New Mexico indicate that vadose zone characteristics and waste properties contribute most to the successful prediction of contamination through the use of the overall groundwater contamination potential score. Vadose zone properties comprise the only hydrogeologic characteristics considered in the SIA methodology to assess contamination potential. Hydrogeologic parameters included in the groundwater quality and groundwater availability steps in the SIA reflect the importance of the

aquifer as a water source, rather than its potential for contamination. One important consideration that was not included in the present study was the age of the impoundment. Many of the sites are less than 15 years old, so a number of the sites receiving a low or moderate contamination potential score may eventually become contaminated. Other factors such as rate of discharge into the impoundment and confidence in available data should be considered in predicting the contamination potential at surface impoundments. (Baker-IVI)
W84-02815

EVALUATING SYSTEM FOR GROUNDWATER CONTAMINATION HAZARDS DUE TO GAS-WELL DRILLING ON THE GLACIATED APPALACHIAN PLATEAU,
Allegheny Coll., Meadville, PA.
S. S. Harrison.
Ground Water, Vol. 21, No. 6, p 689-700, November-December, 1983. 12 Fig, 2 Tab, 2 Ref.

Descriptors: *Groundwater pollution, *Gas-well drilling, Appalachian Plateau, Pennsylvania, Glacial drift, Natural gas, Geohydrology, Groundwater movement, Geologic fractures, Permeability, Hydraulic gradient.

Limited, but increasing, groundwater contamination is occurring in the Glaciated Appalachian Plateau area of northwestern Pennsylvania due to recent drilling for natural gas in that area. The contamination hazard of a given site can be assessed through the evaluation of hydrogeologic parameters at the site including groundwater flow systems, permeability of surficial sediments, and the presence of fracture zones. Most hazardous sites appear to be located on or near valley walls of major drainageways. The relatively steep hydraulic gradient, the frequent presence of highly permeable surficial sediments, and the low to moderate dilution of contaminants along the intermediate length flow paths at these sites all contribute to a relatively high pollution hazard. In addition to locating gas wells in high hazard hydrogeologic zones, allowing the annulus of gas wells to become pressurized is the other major factor contributing to aquifer contamination. (Baker-IVI)
W84-02816

WATER QUALITY MANAGEMENT WITH TIME VARYING RIVER FLOW AND DISCHARGER CONTROL,
Louvain Univ. (Belgium). Centre for Operations Research and Econometrics.
J.-P. Herbay, and Y. Smeers.
Water Resources Research, Vol. 19, No. 6, p 1481-1487, December, 1983. 1 Fig, 4 Tab, 32 Ref.

Descriptors: *Water quality management, *River flow, *Wastewater treatment, Cost analysis, Water pollution sources, Mathematical models.

An extension of the classical river quality management problem is presented that allows for time varying operation of the treatment plants. The hydrology of the river is represented by a set of steady state flow regimes; a river water quality model is used for each of these regimes to give a constraint set to be imposed on the discharges in order to achieve the stream standards during that regime. The objective function distinguishes between investment costs, fixed operating costs, and variable operating costs. A treatment system is sought that minimizes the sum of these costs, taking account of the possibility of operating the treatment system at various different levels during the year. The model is quantified and tested on an example. (Author's abstract)
W84-02851

HEAT DISCHARGE REGULATIONS AND THE PROBLEM OF VARIABILITY OF NATURAL WATER TEMPERATURE,
Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Environmental Dept.
H. E. Sweers.
Water Science and Technology, Vol. 15, p 119-133, 1983. 11 Fig, 2 Tab, 11 Ref.

Descriptors: *Heated water, *Regulations, *Natural waters, *Water temperature, International agreements, Thermal pollution, Thermal stratification.

Cooling water regulations are designed to minimize possible harmful effects of cooling water discharges on the aquatic environment. The philosphy behind the various regulations is not always the same. Regulations can set design requirements for cooling water systems in such a manner that harmful conditions can not develop in the environment during normal operation of the system. On the other hand, regulations can be drafted with the sole purpose to limit the values of certain parameters in the environment while the system is in operation. An overview is given of the regulations for cooling water discharges in force in some European countries. There are certain problems that arise from the adherence to the regulations especially problems arising from the horizontal variability of the water temperature. The horizontal variability may be quite large even in seemingly homogeneous water bodies. Even when the monthly or yearly mean temperatures are almost equal, instantaneous temperature differences up to 2-4 K may occur at locations only a few kilometers apart. (Murphy-IVI)
W84-02939

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MANAGEMENT TRAINING AS A TROUBLESHOOTING TOOL,
Metcalf and Eddy, Inc., Boston, MA.
W. Peterson, and G. Manolakis.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1051-1056, August, 1983.

Descriptors: *Management planning, *Training, *Wastewater treatment facilities, Troubleshooting, Education, Planning, Costs.

Key elements of an effective management training program include: thorough evaluation/needs assessment by experienced personnel; frank communications with the political/administrative leaders and subsequent committment by those leaders to address problems; initials awareness training aimed at supervisors and focusing on leadership, communications problem solving, and human relations; parallel interactions with technical troubleshooting; and follow-up coaching to assist the supervisor in the work place. Management training should be a critical part of startup training programs for new facilities, should be part of every plant's ongoing training program, and is critical to troubleshooting success. The management training program represents a small fraction of the total troubleshooting or start-up effort in every instance, but its impact on the outcome in either case is substantial. Management training is highly cost effective. (Baker-IVI)
W84-02572

SURVIVING THE JOHNSTOWN, PA., FLOOD,
Laurel Management Co., Johnstown, PA.
For primary bibliographic entry see Field 4A.
W84-02667

MULTIPLE RESERVOIR SYSTEM SCREENING MODELS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, B. F. Sule, and D. Pei.
Water Resources Research, Vol. 19, No. 6, p 1383-1393, December, 1983. 3 Fig, 4 Tab, 41 Ref.
OWRT project B-094-NY, grant 14-34-0001-1250.

Descriptors: *Reservoirs, *Model studies, Decision making, Planning, Multireservoir networks, Reservoir releases.

A deterministic reservoir screening model based upon the historical mean monthly flows did not provide sufficient reservoir capacity to achieve reasonable system reliabilities for the design of a large multiple-reservoir system. Three models that explicitly describe the anticipated reliability of multiple reservoir system releases were considered. Of the linear decision rule (LDR) chance-constrained models, those using the S type release rule structure substantially overestimated reservoir capacity requirements. The designs obtained with LDR models that use the SQ type release rule structure were more reasonable but still were not always satisfactory. The recently developed yield model consistently produced reasonable reservoir system designs with release reliabilities near the target. The operating policies produced by the LDR screening models, when stimulated, failed to utilize available water and storage space efficiently, given the objectives of the assignment. For a multiple reservoir system with three reservoirs in parallel, more efficient operating policies were obtained by using Bower's space rule. These results are consistent with those presented by Stedinger for single reservoir operation. (Baker-IVI)
W84-02841

CONSERVATIVE ESTIMATION OF GROUNDWATER VOLUMES: APPLICATION OF LINEAR PROGRAMMING TO TRITIUM DATA,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
For primary bibliographic entry see Field 4B.
W84-02893

6B. Evaluation Process

A MANAGEMENT APPROACH TO ENERGY COST CONTROL IN WASTEWATER UTILITIES,
Peat, Marwick, Mitchell and Co., Washington, DC.
W. M. Prindle, D. A. Buell, and L. J. Scully.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1239-1243, October, 1983. 7 Fig, 1 Tab.

Descriptors: *Decision making, *Wastewater treatment, *Economic aspects, Planning, Management, Energy, Cost analysis.

Cost-effectiveness energy management in wastewater treatment plants should consider specific cost elements of energy use in the plant as a whole and in individual process units. Energy efficiency measures, to achieve maximum cost savings, must be designed to address the specific features of the plant's electricity costs. A time-based cost profile must be developed to accurately evaluate conservation options. To the extent that demand changes and time of day or seasonal features are built into the electric costs, the strategy should include the development of detailed load data on major treatment units, and use to maintain accurate time-based cost profiles; consideration of added instrumentation to afford data and control capabilities needed for effective load management; evaluation of modest load deferral options such as rescheduling some solids processing to off-peak hours on a daily basis; exploration of methods to control monthly and annual peaks, such as using wet wells to their maximum capability, flow equalization ponds, reduction of storm related combined sewer flow, and reduction of infiltration and inflow; and consideration of use of internal electric generation for peak load reduction. (Baker-IVI)
W84-02592

LEAST COST PROCESS DESIGN FOR GRANULAR ACTIVATED CARBON ADSORBERS,
Zenon Environmental, Inc., Burlington (Ontario).
R. M. Narbaitz, and A. Benedek.
Journal of the Water Pollution Control Federation, Vol. 55, No. 10, p 1244-1251, October, 1983. 12 Fig, 2 Tab, 5 Ref.

Descriptors: *Cost analysis, *Activated carbon, *Adsorbers, Wastewater treatment, Adsorbents, Adsorption, Design criteria, Planning, Manage-

ment, Decision making, Economic aspects, Model studies, Computers.

A newly developed design package, called MASTOR, incorporates a recent breakthrough in the understanding of the adsorption process. This package simulates the column's performance and can determine the carbon usage and the cost of constructing and operating different types of column arrangements, thereby providing the possibility of finding the least cost design. MASTOR stands for McMaster Adsorption Systems Optimization Routines and consists of a set of computer programs that models and estimates the costs of four different types of column configurations: single column systems, series systems, parallel systems, and parallel-series systems. (Baker-IVI)
W84-02593

PLANNING FOR ALKALI LAND RECLAMATION UNDER RAINFALL UNCERTAINTY,
Central Soil Salinity Research Inst., Karnal (India). Div. of Agricultural Engineering.
N. K. Tyagi, and V. V. D. Narayana.
Ecological Modelling, Vol. 20, No. 4, p 243-258, December, 1983. 5 Fig, 6 Tab, 12 Ref.

Descriptors: *Land reclamation, *Rainfall, *Alkaline soils, *Planning, *Water use, Model studies, Stochastic process, Land use, Haryana Canal, India.

For the reclamation and utilization of alkali soils, which are characterized by high pH, high exchangeable sodium percentage, and low infiltration rate, for crop production, there is a highly water-dependent technology. A chance-constrained linear programming model with rainfall as stochastic input was developed to plan optimal land and water use in alkali soils under reclamation. The model is based on the water balance of a typical alkali catchment in the command area of the Western Jamuna Canal in Haryana (India). The zero-order decision rule has been used to obtain the deterministic equivalent of chance constraint and optimal solutions have been obtained for four levels of rainfall probability. The application of the model to a typical alkali area of the Indo-Gangetic plains indicates that great risks are taken if reclamation programs are undertaken on the basis of mean rainfall data. For sustained higher-cost alkali land reclamation technology, it is essential that the stochastic nature of the rainfall input is taken into consideration and that land and water use plans are developed at a higher degree of security. (Moore-IVI)
W84-02837

IMPROVED RISK AND RELIABILITY MODEL FOR HYDRAULIC STRUCTURES,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W84-02845

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 1. ANALYSES AND CONCEPTS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. Krysztofowicz, and D. R. Davis.
Water Resources Research, Vol. 19, No. 6, p 1423-1429, December, 1983. 3 Fig, 43 Ref. NWS contract 6-35229, NSF grant CEE-8107204.

Descriptors: *Flood forecasting, *Economic evaluation, *Mathematical models, Warning systems, Decision making, Flood damage, Economic aspects, Flood protection.

Determination of the value of flood forecasts at a microeconomic level necessitates the consideration of numerous hydrologic, organizational, behavioral, and economic factors. These factors and their interactions are captured in a concept of a flood forecast-response (FFR) system. The forecast system extends from the collection of data through the forecasting of floods to the dissemination of warnings. The response system encompasses decision making by the floodplain dweller (decision maker, DM) and the protective actions taken. A methodology is presented which concerns specifically the economic evaluation of the effectiveness of riverine flood forecasts as a means of reducing property damage. The methodology is built of a model of the FFR process and a performance theory. The first element provides a comprehensive mathematical description of the physical FFR process which takes place during floodings; it outputs the expected annual losses (cost of protective action plus flood damage) incurred by the floodplain dweller under several scenarios. The second element establishes the performance measures and expresses them in terms of the outputs of the FFR model; the measures consist of values (expected annual reductions of the loss), efficiencies, and expected opportunity losses. The performance theory has three attractive features. First, the sufficient statistic of system performance consists of only four numbers; thus the computational effort required to evaluate a sysem is relatively small. Second, the evaluations of FFR(DM) systems can be aggregated to obtain an evaluation of the FFR(reach) system. Third, in each case, a display of at most nine numbers (three values, three efficiencies, three expected opportunity losses) provides a comprehensive picture of the system. The values constitute the benefit entry to the benefit-cost or cost-effectiveness analysis. The efficiencies provide a means of comparing the performance of system components. The expected opportunity losses define the upper bounds on the values of different system improvements. (Moore-IVI)
W84-02846

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 2. THEORY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. Krzysztofowicz, and D. R. Davis.
Water Resources Research, Vol. 19, No. 6, p 1431-1440, December, 1983. 5 Fig, 3 Tab, 5 Ref. NWS contract 6-35229, NSF grant CEE-8107204.

Descriptors: *Flood forecasting, *Economic evaluation, *Flood damage, Economic aspects, Markov chain, Decision making, Mathematical models.

A methodology for evaluation of the performance of flood forecast-response (FFR) systems is presented. It is built of (1) a model of the FFR process and (2) a set of performance measures. The FFR process is formulated as a finite, random duration, Markovian decision process which outputs the expected annual loss (cost of response plus flood damage sustained). The sequence of forecasts of the flood crest and the actual river stages are described by a two-branch Markov chain of order one. The decision maker's response is represented by a strategy defined on a three-dimensional state vector and time. The performance measures consist of a value, an efficiency, and an expected opportunity loss for each system component as well as the total system. They are defined on a vector of outputs, each output being computed for a distinct scenario of system operation. Two evaluation models are constructed: one for a single decision maker and another for an arbitrary collection of decision makers along a reach (e.g., a community). (Author's abstract)
W84-02847

A METHODOLOGY FOR EVALUATION OF FLOOD FORECAST-RESPONSE SYSTEMS; 3. CASE STUDIES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. Krzysztofowicz, and D. R. Davis.
Water Resources Research, Vol. 19, No. 6, p 1441-1454, December, 1983. 18 Fig, 11 Tab, 14 Ref. NWS contract 6-35229, NSF grant CEE-8107204.

Descriptors: *Flood forecasting, *Economic evaluation, *Flood damage, Decision making, Mathematical models, Economic aspects, Flood protection, Pennsylvania, Milton, Texas, Victoria, Mississippi, Columbus.

Case studies are reported to illustrate a methodology for evaluation of the performance of flood forecast-response (FFR) systems. The methodology concerns specifically the economic evaluation of the effectiveness of riverine flood forecasts as a means of reducing property damage. The case studies include the evaluation of the FFR systems in three communities: Milton, Pennsylvania; Victoria, Texas; and Columbus, Mississippi. The first study is reported in greater detail, and then a comparative analysis of all three systems is presented. An example is given of evaluation of the economic worth of flood forecasts from the viewpoint of an individual decision maker. The methodology can serve as a decision aid to an individual decision maker who wants to make optimal use of flood forecasts, an evaluation tool for a river forecast service which is concerned with the design and operation of flood forecast systems, a planning aid to urban planners and decision makers who are concerned with floodplain management and disaster-preparedness programs for communities. Evaluation of he performance of an FFR system requires knowledge of human response behavior. The economic value of an FFR system is very sensitive to the strategy the decision maker employs in response to the flood forecasts. Nonoptimal response strategy does not allow the full potential of the forecast system to be realized. If, as a result of the limited lead time of the forecasts, the decision constraint is binding, then the optimal strategy is anticipatory. Since commercial and industrial establishments are often located low in the floodplain, and since their managers have the capability of understanding, developing, and using sophisticated response strategies, it appears that user-tailored flood forecasts have a large potential for extending the economic benefits of weather information. (Moore-IVI)
W84-02848

CATEGORY-UNIT LOSS FUNCTIONS FOR FLOOD FORECAST-RESPONSE SYSTEM EVALUATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. Krzysztofowicz, and D. R. Davis.
Water Resources Research, Vol. 19, No. 6, p 1476-1480, December, 1983. 9 Fig, 1 Tab, 16 Ref. NWS contract 6-35229, NSF grant CEE-8107204.

Descriptors: *Flood damage, *Flood forecasting, *Economic evaluation, Warning systems, Decision making.

Economic evaluation of the performance of a flood forecast-response system requires a large amount of information for the estimation of a loss function. This function must encode the cost of protective action undertaken in response to flood warnings and the flood damage sustained. The concept of category-unit functions is exploited to reduce field survey demands and to circumvent high computation requirements. The loss function consists of a unit damage function, a unit cost function, and a unit reduction function; the degree of response that can be actually implemented is bounded by a decision constraint function. These four functions are estimated from data of various origins for seven categories of structures and three categories of decision makers. (Author's abstract)
W84-02850

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST OF CLEAN WATER--IMPACT ON SMALL COMMUNITIES,
McNamee, Porter and Seeley, Ann Arbor, MI.
For primary bibliographic entry see Field 5D.
W84-02565

THE EFFECTS OF A CHANGE IN THE VARIABILITY OF IRRIGATION WATER,
Utah State Univ., Logan. Dept. of Economics.
K. S. Lyon.
Water Resources Research, Vol. 19, No. 5, p 1122-1126, October, 1983. 3 Tab, 4 Ref.

Descriptors: *Irrigation water, *Economic impact, *Variability, Economic aspects, Profit, Stochastic process, Water resources development.

This paper examines the short-run effects upon several variables of an increase in the variability of an input. The measure of an increase in the variability is the 'mean preserving spread' suggested by Rothschild and Stiglitz (J. Econ. Theory, 2,225-243, 1970). The variables examined are real income (utility), expected profits, expected output, the quantity used of the controllable input, and the shadow price of the stochastic input. Four striking features of the results follow: (1) the concepts that have been useful in summarizing deterministic comparative static results are nearly absent when an input is stochastic; (2) most of the signs of the partial derivatives depend upon more than concavity of the utility and production functions; (3) if the utility function is not 'too' risk averse, then the risk-neutral results hold for the risk-aversion case; (4) if the production function is Cobb-Douglas, then definite results are achieved if the utility function is linear or if the 'degree of risk-aversion' is 'small.' (Author's abstract)
W84-02758

MARKET SIMULATIONS FOR IRRIGATION WATER RIGHTS: A HYPOTHETICAL CASE STUDY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. D. C. Wong, and J. W. Eheart.
Water Resources Research, Vol. 19, No. 5, p 1127-1138, October, 1983. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Water rights, *Irrigation water, *Simulation, *Water rights markets, Permits, Water use, Water allocation, Economic aspects.

The efficiency of two marketable water rights systems in a lentic (lakelike) structure is assessed quantitatively for a case study based on hypothetical irrigation water use. Water rights are simulated on the bases of (1) the expected values of water rights to the users and (2) perfect foresight on the parts of users, and the economic outcomes of these markets are evaluated from both ex ante and ex post perspectives. The market outcomes are compared to the optimal (efficient) scheme and to two alternative nonmarket policies. Distributional aspects of the markets are examined on the basis of individual payoff. Simulation results show that higher efficiency is obtained for the two market systems than for the nonmarket policies and that the market systems recoup about 95% of the economic value of the optimal distribution. The results suggest that most of the 5% efficiency loss should be attributed to the design of the market system itself (i.e., the restrictions imposed by the definition of the rights and/or the water rights allocation policy), rather than the users' inability to predict future events. (Author's abstract)
W84-02759

THE ECONOMICS OF IRRIGATION WITH NONUNIFORM INFILTRATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 4A.
W84-02844

6D. Water Demand

USE OF SURFACE WATER FOR REARING CHANNEL CATFISH IN PONDS,
Fish Farming Experimental Station, Stuttgart, AR.
D. L. Tackett, and R. R. Carter.
Progressive Fish-Culturist, Vol. 45, No. 3, p 179-180, July, 1983. 2 Tab, 2 Ref.

Descriptors: *Fish farming, *Water quality, *Catfish, Turbidity, Surface water, Filtration, Water treatment, Coagulation, Ponds, Turbidity, Aquatic plants, Arkansas.

The level of the water table is dropping as much as 30 cm in some areas of Arkansas each year, of which about 8% is a result of fish farming. While more surface water should be developed for fish farming, exposure to sources of pollution is a problem. The use of filtration or treatment with 20 mg/L coagulant were tried to improve the quality of the surface water for fish production. Surface water characteristics varied over a wide range due to irregular streamflow, rainfall, land use in the drainage area, and other factors. Treatment of raw water with coagulant significantly reduced turbidity on three of the four test dates, but had no effect on biochemical oxygen demand, pH, alkalinity, carbon dioxide, or hardness. Surface waters containing clay turbidity had no detrimental effect on fish husbandry. The type of water supplied (raw, treated, or filtered) did not affect fish production. Some turbidity may be desirable as clear water ponds may develop dense aquatic vegetation making them difficult or impossible to seine. In 1980, emergent and submerged vegetation did develop in ponds containing raw water treated with coagulant at 20 mg/L. Three of the six ponds with treated water were difficult to seine and the other three could not be seined. Vegetation posed a seining problem in only one of the six raw water ponds. In 1981, when less coagulant was used and water was more turbid in all ponds, all 16 ponds could be seined without difficulty. (Baker-IVI)
W84-02510

RURAL WASTEWATER PLANNING,
New York State Dept. of Environmental Conservation, Albany.
M. M. Wolfson.
Journal of the Water Pollution Control Federation, Vol. 55, No. 8, p 1042-1050, August, 1983. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Planning, *Wastewater facilities, *Rural areas, Grants, Wastewater disposal, Small communities, Domestic wastes, Wilmington, New York.

The town of Wilmington, New York was selected by the NYSDEC as a pilot project to determine how a small community could use the EPA Construction Grants Program to solve its wastewater disposal problems. The study suggests that new planning approaches are needed because the current program does not incorporate a suitable procedure for solving wastewater disposal problems in small communities. The community of Wilmington is very rural in nature, characterized by steep rugged terrain typical of the high peaks region of the Adirondack Mountains. Very high ground water and hillside springs can be found in the more remote and mountainous areas. All wastewater is disposed of by on-site systems because there are no central collection and treatment facilities. Many of the on-site systems have failed. The most densely settled portion of the town is served by a municipal water system; the remaining residents rely on private wells for their water supply. In many areas it appears that groundwater is being impaired because of the discharge of improperly treated wastewater. A HUD Community Development Block Grant for improving properties of low-income families allowed the replacement or repair of some 60 malfunctioning on-site wastewater disposal systems. A NYSDEC Survey was conducted covering 181 wastewater generating facilities, both private and commercial. The survey indicated that more resources should be devoted to the regulation of on-site systems, that public management of on-site systems is necessary to supplement existing regulatory controls, public education is an absolute necessity in improving rural wastewater disposal, facilities planning conducted under the EPA Construction Grants Program must be streamlined, that small community officials must accept responsibility to protect public health, that regulatory personnel and project sponsors should be fully aware of the effect that local politics can have on planning proposal, and that the concept of a wastewater disposal district represents a relatively new and untried uption for small communities and is often impacted by complex legal issues. (Baker-IVI)
W84-02571

ESTIMATING THE EFFECT OF WATER QUALITY ON SURFACE WATER SUPPLIES,
Anglian Water Authority, Huntingdon (England). Dept. of Operational Planning.
A. E. Warn, and C. Page.
Water Research, Vol. 18, No. 2, p 167-172, 1983. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Water quality, *Regression analysis, *Water supply, River flow, History, Mathematical models, Water quality control, Simulation, Nitrates, Reservoir operation, Pumped storage, Water pollution control.

Records of river water quality provide information on the suitability of rivers for various uses. In assessing the future of water supplies, these records must be supplemented with information about the effects of effluent discharges, abstractions, changing patterns of land use and hydrological conditions not encountered in the period covered by the record. A method of accounting for these effects uses multiple regression analysis to produce long sequences of river quality data, which are compatible with historical records of river flow. The method has been applied to predict levels of nitrate, sulfate, and chloride in rivers and pumped storage reservoirs. It enables a proper evaluation of the methods of controlling the quality of water put into public supply. Results for nitrate show that to operate intakes according to river quality is a poor method of controlling quality in impoundments. (Moore-IVI)
W84-02746

CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER FOR IRRIGATED AGRICULTURE: RISK AVERSION,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 4B.
W84-02756

DETERMINANTS OF FARM WATER SUPPLY IN THE LOWER BHAVANI PROJECT, COIMBATORE, SOUTH INDIA,
Minnesota Univ., Minneapolis. Dept. of Agriculture and Applied Economics.
K. Palanisami, and S. R. Subramanian.
Water Resources Research, Vol. 19, No. 6, p 1403-1409, December, 1983. 3 Fig, 6 Tab, 12 Ref.

Descriptors: *Water supply, *Irrigation canals, *India, *Coimbatore, *Lower Bhavani Project, Social aspects, Conjunctive use, Water stress, Paddy crops, Water allocation, Water management.

In India, systems of canal irrigation have been designed and operated with the objective of maximizing the number of irrigation beneficiaries. They are aimed at providing water to the maximum area possible, and thus the principles of providing the optimum water to the crops and equity in the distribution of water to all the beneficiaries of the canal system have not been given due recognition. A study was conducted in the Lower Bhavani Project (LBP) Area in Coimbatore District, Tamil Nadu during 1978-1979 with the objective of identifying the determinants of farm water supply. The distance of a farmer's field from the outlet of the supply channel, size of the farm, number of intervening farmers, social characteristics, and possession of wells for supplementing the canal water were the key variables determining the canal water supply at the farm level. Direct distance and lateral distances of the supply channel in the head and middle portions and direct, lateral, and sublateral distances in the tail portion markedly influenced the stress days and yield of paddy crops. The buildup of stress days was higher at the direct distance category. Under the current method of allocating water to only half of the command area in each year and with the consequent water distribution problems, changes in the system of water distribution below the outlet would have more significant impacts on farm level water supply in the Lower Bhavani Project than changes above the outlet. Changes in water allowance concept, introduction of on-farm development activities, conjunctive use of surface and groundwater, and introduction of changes in the main system man-

agement were suggested for improving the performance of the system as a whole. (Moore-IVI)
W84-02843

TIME PATTERNS OF WATER USE IN SIX TEXAS CITIES,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and E. Parzen.
Journal of Water Resources Planning and Mangement, Vol. 110, No. 1, p 90-106, January, 1984. 5 Fig, 6 Tab, 17 Ref.

Descriptors: *Time series analysis, *Water use, *Texas, Consumptive use, Prediction, Andrews, Canyon, Littlefield, Conroe Henderson, Huntsville.

The time variation of data from 6 Texas cities may be divided into long memory (on average, 70% of total variation), short memory (15%) and residual error (15%). Long-memory results from trend and seasonal variation. In each city, trend is analyzed by stepwise regression of mean annual water use on population, number of water connections, household income and water prices, in which population is consistently the most significant explanatory variable for trends in water use from year to year. Short-term memory results from autocorrelation and climatic correlation. Climate correlation is strong in the three cities in the semiarid High Plains of Texas where if one inch more than mean monthly rainfall or pan evaporation occurs, it results on average in a 10 gpcd (38 Lpcd) change in mean monthly water use (decrease for rainfall, increase for evaporation). In three cities in humid East Texas the response of water use to weather variations is weaker. Confidence limits on modeled water use adequately envelop the response of water use to the droughts experienced by these cities from 1961-1978. (Murphy-IVI)
W84-02922

6E. Water Law and Institutions

AN ANALYSIS OF REGULATIONS: THEIR IMPACT ON EFFLUENT MANAGEMENT THROUGH PROCESS CONTROL,
National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
W. J. Gillespie, and R. O. Blosser.
Tappi Journal, Vol. 66, No. 12, p 34-36, December, 1983. 3 Ref.

Descriptors: *Decision making, *Regulations, *Effluents, Wastewater disposal, Pulp and paper mills, Pulp and paper industry, Industrial wastes.

The current structure of regulations governing effluent discharges are examined along with anticipated trends in the development of these regulations. Included are those aspect of the regulations that may influence the development of an individual pulp and paper mill's control strategy. Examples are given to illustrate the tools available to mill management for making decisions as to the most cost-effective approach in a given situation. The overall structure and operation of the Effluent Guidelines and the NPDES permit program do not offer any particular incentive for mills to achieve discharge limitations via internal process control rather than external treatment technologies. However, there are some detailed aspects of the program which may provide limited incentives toward the internal control approach. Persons responsible for mill compliance programs are urged to undertake a careful study of the emerging regulations and to maintain a close working relationship with EPA and state agency officials. (Baker-IVI)
W84-02913

HEAT DISCHARGE REGULATIONS AND THE PROBLEM OF VARIABILITY OF NATURAL WATER TEMPERATURE,
Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands). Environmental Dept.
For primary bibliographic entry see Field 5G.
W84-02939

6F. Nonstructural Alternatives

WATERSHED LAND-USE PLANNING UNDER UNCERTAINTY,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, H. G. Wenzel, Jr., and L. D. Hopkins.
Environment and Planning A, Vol. 15, No. 7, p 987-992, July, 1983. 15 Ref.

Descriptors: *Land use, *Flood plain management, *Planning, *Model studies, Uncertainty, Decision making, Watersheds, Regulations.

The pattern of land use can affect flood damage either by eliminating from the floodplain those land uses that are susceptible to flood damage or by reducing the increase in flood peaks that occurs as a consequence of development. A model of watershed land-use planning is formulated that improves on existing models by recognizing that land-use decisions have uncertain outcomes and that land uses change over time. Although land uses may be selected as the intended outcome of decisions or regulations, there is no certainty that these intended land uses will occur or that they will remain throughout the period of interest. Although a heuristic solution approach has been proposed, it is doubtful whether the effort to gather the required information would be justified in applying the model to a real watershed problem. The model is important, however, becauses it formalizes a more realistic concept of the problem of choosing land-use decisions to aid in achieving flood management objectives. (Moore-IVI)
W84-02639

CONTRACTUAL REQUIREMENTS TO IMPLEMENT WATER RECLAMATION,
Montgomery (James M.), Inc., Pasadena, CA.
R. L. Anderton, and N. G. Hixson.
Industrial Water Engineering, Vol. 20, No. 3, p 13-20, 1983.

Descriptors: *Legal aspects, *Water reuse, *Reclaimed water, Pulp and paper industry, Electroplating industry, Industrial wastes, Textiles, Contracts, Recreational facilities.

Major contractual considerations in developing water reuse projects are quality, quantity, price and health concerns due to the type of water supplied. These questions are addressed in this major reuse market survey which dealt with pricing, health concerns, industrial applications, specifics for the textile and paper industries as well as electroplating and glass container manufacturing industries. Oil well injection for repressurization and landscape irrigation uses of reclaimed water are touched upon. A sample reuse contract between a reclaimed water supplier, a retail water municipal surveyor, and a private country club for the purpose of providing reclaimed water in lieu of fresh water for golf course and landscape irrigation is offered. The draft document is not a legal contract, but is intended to illustrate the basic points that should be considered in a three party reuse contract. (Baker-IVI)
W84-02666

ANALYZING ALTERNATIVE FLOOD DAMAGE REDUCTION MEASURES ON SMALL RURAL WATERSHEDS USING MULTIPLE RETURN PERIOD FLOODS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter, and D. R. Morgan.
Water Resources Research, Vol. 19, No. 6, p 1376-1382, December, 1983. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Flood control, *Nonstructural alternatives, *Agricultural watersheds, Economic feasibility, Flood damage, Crops, Flood-control storage, Manitoba, Wilson Creek Watershed.

In many areas of rural Manitoba, conventional flood control measures such as diking and channel clearing are proving to be ineffective, both in their cost and in their ability to reduce flood damages. A heuristic techniques has been developed to assess the economic feasibility of a number of unconventional measures for flood damage reduction. Two measures considered are: (1) substitution of crops with a low susceptibility to flood damage for crops with a high susceptibility to flood damage and (2) storage of floodwaters on poor crop land to prevent flood damage on better crop land downstream. The probability of occurrence of various flood events is incorporated into the technique. The method is based upon the dynamic programming optimization technique and has been developed with particular emphasis on the Wilson Creek Watershed on the eastern boundary of Riding Mountain National Park, Manitoba, Canada. (Author's abstract)
W84-02840

6G. Ecologic Impact Of Water Development

EFFECTS OF COMPLETE REDD DEWATERING ON SALMONID EGG-HATCHING SUCCESS AND DEVELOPMENT OF JUVENILES,
Idaho Cooperative Fishery Research Unit, Moscow.
D. W. Reiser, and R. G. White.
Transactions of the American Fisheries Society, Vol. 112, No. 4, p 532-540, July, 1983. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Salmon, *Redds, *Hatching, *Drying, *Streamflow depletion, Larvae, Temperature, Sediments.

The effects of prolonged stream desiccation on development of salmonid eggs were simulated for steelhead Salmo gairdneri and spring chinook salmon Onchohynchus tshawytscha. Recently fertilized eggs were placed in artifical redds and subjected to controlled water flows in outdoor laboratory channels. Control redds were continuously submerged. 'Dewatered' redds were exposed to air; water flowed through the substrate 10 cm below the eggs. Eggs were dewatered 1-4 weeks (steelhead) or 1-5 weeks (chinook salmon) before they were returned to water in hatchery incubators, where hatching success and subsequent fry development were monitored. Several combinations of cobble, coarse sediment, and fine sediment used to cover eggs did not influence egg development, provided the mixtures retained at least 4% moisture by weight. Dewatered eggs hatched sooner than control eggs; faster hatch was associated with higher substrate temperature in exposed redds. Hatching success of dewatered eggs averaged 94% for steelhead (control: 88%) and 76% for chinook salmon (control: 56%) and was not affected by the time eggs had been dewatered. After 8 (chinook salmon) and 8.5 (steelhead) weeks of rearing, juveniles from dewatered and control eggs had grown equally well. (Author's abstract)
W84-02528

CHARACTERIZATION OF TRACE AND TOXIC MATERIALS IN SEDIMENTS OF A LAKE BEING RESTORED,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. P. Gambrell, C. N. Reddy, and R. A. Khalid.
Journal of the Water Pollution Control Federation, Vol. 55, No. 9, p 1201-1210, September, 1983. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Lake restoration, *Lake sediments, *Dredging, *Land disposal, Productive use, Cadmium, Lead, Zinc, City Park Lake, Baton Rouge, Louisianna, Infiltration, Soil properties, Lime, Sediments, Spoil banks, Water pollution control.

Sediment materials were characterized and the levels of nutrients and toxic materials present were determined form materials gathered from nine sampling sites on City Park Lake, Baton Rouge, LA. The samples were taken to determine the effectiveness of using upland disposal/productive-use alternatives as possible environmentally acceptable methods of placing dredged sediments as opposed to the open-water disposal of dredged sediments

taken during restoration work on lakes. The initial chemical characterization study of City Park Lake indicated lead, zinc, and cadmium levels as areas for concern. Liming to increase dredged material pH should effectively reduce the plant availability of these metals so that plant growth will not be adversely affected, and animal and human health also will not be jeopardized by consumption of these plants. To give faster settling of solids and speed dewatering at the disposal site, lime would probably be introduced to the dredged slurry if hydraulic dredging is used to enhance flocculation of colloidal clay and organics. This will tend to reduce the dissolved levels of the three metals as well. The extent of dilution with surface water at the disposal site, as well as the duration of the dewatering operation also must be determined to evaluate the environmental significance of lead, zinc, and cadmium in the water draining from an upland disposal site. With proper management to minimize adverse effects of potentially toxic materials, the nitrogen, phosphorus, and trace nutrient metal content of the sediments will probably enhance crop production. (Baker-IVI)
W84-02591

CAN TVA CHANGE ITS SPOTS,
F. Powledge.
Audubon, Vol. 85, No. 2, p 60-75, March, 1983. 15 Fig.

Descriptors: *Water quality control, *Water pollution control, Tennessee, Tennessee Valley Authority, Powerplants, Dams, Planning, Management, Conservation, Environmental effects.

Over the years since its beginning the Tennessee Valley Authority became a producer of cheap power, with little concern for the simultaneous production of air, water, and land pollution. While the agency has always maintained staffs and facilities for studying and demonstrating ways to conserve and restore the region's natural resources, far more emphasis was placed on the aspects of power generation, heavy construction, dam building, and river harnessing. Nine major dams were built and 42 more were placed on tributaries. A 650-mile long navigable waterway was carved into the river, up from its junction with the Ohio at Paducah, Kentucky. With the dams came 49 hydroelectric powerplants. In the late 1970s a change in leadership came to the TVA. The change brought with it an increasing concern about the relationship of the TVA to environmental control. TVA's newly articulated mission is being furthered on a number of fronts, from experiments with growing catfish in leftover heated water from a steam plant to research into new forms of fertilizers. Programs of special interest to the environment are those involving the stewardship of the valley's water, air, and land, and those that encourage conservation and reuse of its renewable resources. A clear demonstration of TVA's change of heart may be found in its attitude toward energy conservation and the use of renewable energy sources such as the light and heat from the sun. (Baker-IVI)
W84-02618

VALUATION OF THE ENVIRONMENTAL IMPACT OF WETLAND FLOOD PROTECTION AND DRAINAGE SCHEMES,
University of East Anglia, Norwich (England). School of Environmental Sciences.
R. K. Turner, D. Dent, and R. D. Hey.
Environment and Planning A, Vol. 15, No. 7, p 871-888, July, 1983. 3 Fig, 7 Tab, 39 Ref.

Descriptors: *Environmental effects, *Wetlands, *Drainage, *Flood control, *Cost-benefit analysis, Economic aspects, Farming, Land development, Yare Barrier, Norfolk, England.

Large areas of the remaining wetland in the United Kingdom are faced with virtual extinction because of the pressures engendered by high productivity farming practices, reinforced by subsidized land drainage and flood protection schemes as well as by price supports for agricultural produce in the European Economic Community. Unique environmental resources are being put at risk by changing farming methods and in particular by arable conversion schemes. A case study, the Yare Barrier Proposal in Norfolk, is used to analyze and evaluate the environmental impacts of drainage and flood protection schemes on the surrounding wetland ecosystems. An opportunity cost model is used to estimate the costs and benefits involved in this policy decision on preservation versus development. The case for the agricultural development of the wetlands made on the grounds of economic efficiency is not a strong one. (Author's abstract)
W84-02638

FORECASTING THE IMPACTS OF GLOBAL FORCES ON AMERICA'S WETLANDS,
Fish and Wildlife Service, Washington, DC.
For primary bibliographic entry see Field 2L.
W84-02682

SOURCES OF NITRATES IN GROUNDWATER OF THE COASTAL PLAIN OF ISRAEL; EVOLUTION OF IDEAS,
Ministry of Agriculture, Tel-Aviv (Israel).
For primary bibliographic entry see Field 5B.
W84-02700

THE EFFECTS OF IMPOUNDMENT ON THE DOWNSTREAM MACROINVERTEBRATE RIFFLE FAUNA OF THE RIVER ELAN, MID-WALES,
Welsh Water Authority, Powys (Wales).
R. J. Inverarity, G. D. Rosehill, and M. P. Brooker.
Environmental Pollution (Series A), Vol. 32, No. 4, p 245-267, 1983. 5 Fig, 5 Tab, 37 Ref.

Descriptors: *Dam effects, *Invertebrates, *River Elan, *River Wye, *Wales, Iron, Manganese, Hydrogen ion concentration, Riffles, Coleoptera, Ephemeroptera, Trichoptera, Effluents, Environmental effects.

River water quality and hydrological regime in the River Elan, downstream of an impoundment in an upland catchment in mid-Wales, were considerably different from a nearby naturally flowing river. Concentrations of total iron (mean, 0.26 and 0.61 mg/l in May and September) and manganese (mean, 0.12 and 0.16 mg/l) were elevated in the River Elan compared with the nearby River Wye (iron $<$ or $=$ 0.16 mg/l, manganese $<$ or $=$ 0.01 mg/l). pH in the River Elan (5.3 - 5.5) was considerably lower than the naturally flowing River Wye (6.9 7.2). There were differences in riffle macroinvertebrates, generally collected with a cylinder sampler on two occasions, in the Elan and Wye. A number of taxa were not recorded or were found at relatively low densities in the River Elan: principally these included representatives of the Coleoptera, Ephemeroptera and Trichoptera. Additionally, total densities in the River Wye (mean, 4900/sq m in May) were significantly ($p<0.05$) higher than the Elan (mean, 900/sq m in May). There was no evidence that effluents discharging to the Elan affected the distribution of macroinvertebrates. Differences between the fauna of the impounded River Elan and the naturally flowing River Wye probably resulted from the presence of iron- and manganese- rich deposits in the River Elan - probably derived from metal-rich water from the reservoir - although reduced pH and water temperature downstream of the impoundment could have contributed to the paucity of the fauna. (Author's abstract)
W84-02787

GROUND WATER FOR OIL-SHALE DEVELOPMENT, PICEANCE BASIN, COLORADO,
Geological Survey, Reston, VA.
W. M. Alley.
Ground Water, Vol. 21, No. 4, p 456-464, July-August, 1983. 6 Fig, 1 Tab, 23 Ref.

Descriptors: *Groundwater potential, *Oil shale, *Groundwater management, *Piceance Basin, *Colorado, White River, River basins, Streamflow, Model studies, Reservoirs.

Vast deposits of oil shale are contained in the Piceance basin in northwestern Colorado. Development of this resource will require a large amount of water. A synthetic streamflow model was used to investigate the effects of using conservative estimates of groundwater on the required active storage capacity of a hypothetical reservoir on the White River. The use of groundwater from mine drainage and/or auxiliary wells may have a significant impact on the size and timing of surface-water reservoirs. Thus, groundwater may be an important source of supply, particularly during early development of an oil-shale industry. Further study is needed on the physical availability of groundwater as well as the institutional, legal, and water quality constraints on its use. An important part of the current study was a monthly mass balance of reservoir storage. Reservoir losses due to evaporation and seepage were not included in the mass balance. (Baker-IVI)
W84-02806

PUMPING EFFECTS OF WELLS IN FRACTURED GRANITIC TERRAIN,
British Columbia Ministry of Environment, Victoria.
A. P. Kohut, J. C. Foweraker, D. A. Johanson, E. H. Tradewell, and W. S. Hodge.
Ground Water, Vol. 21, No. 5, p 564-572, September-October, 1983. 14 Fig, 2 Tab, 12 Ref.

Descriptors: *Wells, *Geologic fractures, *Granite, *Pumping, Drawdown, Bedrock, Groundwater supplies, Line sinks, Saanich Peninsula, British Columbia.

Pumping from large-capacity bedrock wells in the granitic terrain of the Saanich Peninsula (British Columbia) results in the development of trough-like cones of depression of marked linearity (line sinks) which may extend more than 1,500 m (4,900 ft) from the pumped wells. The longitudinal axes of the drawdown troughs do not parallel major areal fracture directions, but develop along trends coinciding with the areal intersections of the two prominent bedrock joint sets prevalent in the region and bisect the angels between the sets. The drawdown troughs extended preferentially away from the pumped wells toward local recharge areas in a general direction of increasing regional potentiometric head. This phenomenon may be in part coincidental, as a sufficient number of observation wells were not available downgradient from the pumping wells to delineate the full extent of the drawdown trough. It is likely that the major controls on trough development are related to the orientation, spacing, dimensional characteristics, degree of connectivity and permeability of fractures rather than the regional potentiometric gradient. Occurrence of this line sink phenomenon indicates that fracture anisotropy in granitic terrain has a pronounced effect on the magnitude and direction of drawdown interference about a pumped well. Apart from apparent fracture heterogeneity in the granitic mass, there is yet evidence of hydraulic continuity on a regional scale as indicated by water level responses in the observation wells. (Baker-IVI)
W84-02809

EFFECTS OF AQUIFER INTERCONNECTION RESULTING FROM UNDERGROUND COAL GASIFICATION,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 2F.
W84-02813

7. RESOURCES DATA

7A. Network Design

HOW TO CONSTRUCT REFERENCE DISTRIBUTIONS TO EVALUATE TREATMENT PLANT EFFLUENT QUALITY,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
P. M. Berthouex, and W. G. Hunter.
Journal of the Water Pollution Control Federation, Vol. 55, No. 12, p 1417-1424, December, 1983. 8 Fig, 2 Tab, 1 Ref. EPA grant R809162010.

Descriptors: *Effluents, *Water quality control, *Statistical analysis, Mathematical studies, Statistical methods, Reference distribution, Wastewater treatment, Wastewater treatment facilities, Decision making, Management.

Much time and money are spent making measurements of treatment plant performance. The data should be processed in a way that makes them informative and lead the operator in generally profitable directions. Preferred methods of processing the data are simple, yet statistically valid and useful. The reference distribution is a statistically valid tool which can be derived for any statistic that might increase our understanding of the treatment process. In making the reference distribution, no assumptions about statistical properties of the data are needed. The reference distribution will usually be presented as a histogram, which is a clear picture of what is expected and what is unusual. This picture can be embellished by marking warning levels; for example the levels exceeded only 1 or 5% of the time. The 5% warning level on the reference distribution is robust with respect to selection of the stable and upset portions of the data series. The 1% level will be more sensitive to inclusion or rejection of high values, but subjective selection of the stable periods is acceptable. Incoming data, or statistics calculated from these data, are tested against the warning levels. An alert signaled by the 1% level almost certainly means that plant performance has changed. The 5% warning level gives an alert signal about one day out of twenty, even when the plant is operating in a stable fashion. The reference distribution is a simple graphical tool that is easy to devise and easy to use. Despite its simplicity, it is statistically valid and powerful. (Baker-IVI)
W84-02605

DATA ACQUISITION NETWORKS,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Journal of Environmental Systems, Vol. 13, No. 1, p 43-57, 1983-84. 1 Fig, 2 Tab, 26 Ref.

Descriptors: *Data acquisition, *France, *Belgium, *Networks, Governmental interrelations, Water demand, Water resources.

Studies concerning water resources are a central preoccupation in the majority of developed countries. Data acquisition is an important part of these studies. Data acquisition networks are very costly, and it is imperative that any investments made will yield the desired results. The methods of data acquisition currently in effect in Belgium and France were analyzed. Belgium has a very large problem with water. Although the country has a fairly humid climate and abundant precipitation, consumer demand for water becomes critical in dry years, due to the high population density, the high degree of industrial and agricultural development and the constant need for water in the ship canals. These problems fall within the purview of four ministries: Public Works; Agriculture; Public Health; and Economic Affairs. In 1965, a water commission (Commissariat Royal au Probleme de l'Eau) was set up. It had the responsibility of coordinating all work in this area and assumed the following objectives: make an inventory of water requirements and resources; study the most urgent problems and suggest measures to overcome them; make up a national balance sheet of requirements and resources with a view to establishing a coherent water policy. In France, responsibility in the area of water resources is divided among the Ministries of Agriculture, Industrial and Scientific Development, Economic Affairs, Public Works, Public Health, the Ministry of the Interior and Electricite de France. The permanent water secretariat (SPPE) has the task of setting up an inventory of data and routing the data to users. The center for engineering design and technology research in agriculture, forestry and rural works (CERAFER) organizes studies of rivers and wastes through the regional water management service (SRAE). (Moore-IVI)
W84-02681

7B. Data Acquisition

BIOASSAY EVALUATION OF DIVERSITY AND COMMUNITY COMPARISON INDEXES,
Alabama Univ. in Birmingham. School of Public Health.
For primary bibliographic entry see Field 5C.
W84-02570

EVALUATION OF A SAMPLER FOR LIQUID EFFLUENTS,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
For primary bibliographic entry see Field 5D.
W84-02699

AN IMPROVED TECHNIQUE FOR ESTIMATING MEAN DEPTH OF LAKES,
Corvallis Environmental Research Lab., OR.
For primary bibliographic entry see Field 2H.
W84-02707

SAMPLING FREQUENCY FOR WATER QUALITY MONITORING: MEASURES OF EFFECTIVENESS,
Nichols Applied Management, Edmonton (Alberta).
For primary bibliographic entry see Field 5A.
W84-02757

MEASURING WATER SURFACE AND STREAMBED ELEVATION CHANGES WITH THE ACOUSTIC VELOCITY METERING SYSTEM,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-02771

HYPOTHESIS-TESTING BY MODELLING CATCHMENT RESPONSE,
Hull Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W84-02899

INTERFACING SOIL MOISTURE GYPSUM BLOCKS WITH A MODERN DATA-LOGGING SYSTEM USING A SIMPLE, LOW-COST, DC METHOD,
Institute of Hydrology, Wallingford (England).
I. C. Strangeways.
Soil Science, Vol. 136, No. 5, p 322-324, November, 1983. 7 Fig, 2 Ref.

Descriptors: *Soil water, *Gypsum blocks, *Data-logging system, *Costs, *Direct current, On-site data collections, Gypsum, Soil tension, Soil pressure, Economic efficiency.

Gypsum blocks are useful in field studies of soil moisture as low-cost, if only moderately precise, sensors of soil tension that can be used over a wide range of tensions, unlike manometer or pressure transducer sensors, which are limited to the lower ranges of tension. The development enabled gypsum blocks to be read by a modern data-logging system. It differs from conventional AC methods in using a short-duration DC pulse, thus permitting a simple, low-cost circuit of high stability to be used. The work was done originally to detect the passage of wetting fronts in an arid climate; its application is, however, general. (Murphy-IVI)
W84-02909

BRASS MODEL: PRACTICAL ASPECTS,
Army Engineer District, Savannah, GA.
G. F. McMahon, R. Fitzgerald, and B. McCarthy.
Journal of Water Resources Planning and Management, Vol. 110, No. 1, p 75-89, January, 1984. 6 Fig, 10 Ref.

Descriptors: *Computer models, *Basin Runoff and Streamflow Simulation, *BRASS, Computer programs, Computers, Hydrologic/hydraulic model, Rainfall simulators, Runoff, Flood forecasting, Flood plain management, Savannah River.

The BRASS (Basin Runoff and Streamflow Simulation) model provides flood management decision support for operation of Savannah River system projects. BRASS is an interactive hydrologic/hydraulic model which can perform rainfall-runoff simulation for subareas, using the Soil Conservation Service curve number infiltration procedure, continuously simulate variation in curve number and baseflow for subareas using rainfall and evaporation data, perform unit hydrograph and controlled storage routing of subarea runoff, and perform dynamic streamflow, routing for combining subarea outflows and determining stage, discharge, and velocity histories at points throughout a dendritic river system. The model incorporates and enhances two previously developed hydrologic models and the National Weather Service river forecast model, DWOPER, linked by a command program using 'problem-oriented language' (POL) input. Because BRASS effectively merges hydrologic and hydraulic models for watershed analysis, it has numerous applications in project operations, flood forecasting (including tidally influenced areas), and design of flood or water control structures. (Murphy-IVI)
W84-02921

7C. Evaluation, Processing and Publication

STATISTICAL MODELS FOR WATER QUALITY REGULATION,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 5G.
W84-02577

EXPERIENCES WITH AUTOMATED INFORMATION RETRIEVAL,
Vakgroep Gezondheidstechniek, Delft (Netherlands). Afdeling der Civiele Techniek
H. H. Siebers, and M. W. de Jong-Hofman.
Water Research, Vol. 17, No. 12, p 1715-1719, 1983. 6 Tab, 3 Ref.

Descriptors: *Information retrieval, Water supply, Wastewater treatment, Surface water, Information systems, Bibliographies.

There are two basically different ways to retrieve publications dealing with subjects in the field of water supply, wastewater treatment and surface water: manual and online. Manual searching contains amongst others reading professional journals and bibliographies or abstract journals. With the aid of a computer it is possible to search online in bibliographic data bases. This article mainly deals with online searching. In two practical examples results and expenses are put together. In order to execute a search as complete as possible online searching in several data bases is required. From the results of the searches and from reading the original literature, it is obvious that, if possible and done with special care, manual searching produces more references than online searching. (Author's abstract)
W84-02716

COMPUTATIONAL MODEL FOR THE OHIO RIVER CHUTES AT LOUISVILLE: THE 1972 VIRGIN CONDITIONS,
A. Giorgini, and A. Rinaldo.
Instrument Society of America Transactions, Vol. 22, No. 4, p 55-68, 1983. 12 Fig, 2 Tab, 10 Ref.

Descriptors: *Model studies, *Ohio River, *River chutes, Kentucky, Indiana, River flow, Legal aspects, History, Hydraulic models.

The need for simulation and modeling of the hydraulic behavior of the Ohio River at Louisville's Chutes in the 1792 conditions arose from a legal dispute between Kentucky and Indiana. On June 1st, 1792 when Kentucky was admitted to the Union, its northern boundary was declared to be

the north bank of the river Ohio at low water mark. The same line became the Indiana southern boundary when that state was created on December 11, 1816. Since the 1792 low water mark could not be determined with certainly, the 1895 low water mark was taken was a conservative substitute for it. The 404.7 ft 1895 low water mark was affected by a wing dam whose removal, to restore the 1792 condition lowered the water level to 403.7. There is a definite probability that in 1792 at low waters, Six Mile Island was an Indiana peninsula. It is emphasized that this result demonstrated first within the hydraulic research context by means of computer graphics would be a certainty under the condition that the Knox-Wayne correspondence were interpreted to apply to almost dry conditions along the Chutes. (Baker-IVI)
W84-02932

8. ENGINEERING WORKS

8A. Structures

CHARACTERISTICS OF THE DESIGN AND CONSTRUCTION OF HYDRAULIC-FILL STRUCTURES ON EXISTING RESERVOIRS,
V. F. Kanarskii, V. M. Kondrat'ev, V. A. Ivanon, and M. I. Rogoza.
Hydrotechnical Construction, Vol. 17, No. 3, p 131-136, March, 1983. 5 Fig, 4 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 24-26, March, 1983.

Descriptors: *Dam construction, *Design criteria, Reservoirs, Hydraulic fill, Construction, Powerplants, Zaporozhe nuclear power plant, Balakov nuclear power plant, Nuclear energy.

Characteristics of the design and construction of the dams of the cooling ponds of the Zaporozhe and Balakov nuclear power stations on the reservoirs of the Kakhovka and Saratov hydroelectric stations are discussed. The construction of hydraulic-fill structures detaching individual water areas on existing reservoirs is related to the danger of waves eroding these structures, especially in deep stretches of the reservoirs. The experience of constructing and operating hydraulic-fill structures with a flattened profile shows that their hydrodynamic stability and strength depend on wind and wave action, size and composition of the earth material, and shape of the shoreline being formed by the structure being constructed, and other factors. Correct consideration of the indicated factors and generalization of the experience of operating objects-analogs makes it possible to obtain substantiated engineering solutions when designing and constructing structures for enclosing deep areas on existing reservoirs. (Baker-IVI)
W84-02646

SEISMIC STRESSED STATE OF UNDERGROUND HYDRAULIC STRUCTURES AT THE ROGUN HYDROELECTRIC STATION,
D. V. Monakhenko, Ya. N. Tsukerman, and S. G. Shul'man.
Hydrotechnical Construction, Vol. 17, No. 4, p 151-155, April, 1983. 3 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 13-16, April, 1983.

Descriptors: *Design criteria, *Hydraulic structures, Dams, Powerplants, Hydroelectric powerplants, Seismic properties, Rogun Hydrostation.

The seismic stressed state of a number of underground hydraulic structures was investigated, in particular, one of the variants of the structures of the powerhouse (PHC) complex of the Rogun hydrostation was examined. The structures of the PHC are located in soft rocks and consist of a number of parallel workings of large cross section with a horseshoe configuration with a length of more than 200 m. The mass adjacent to the workings of the rooms of the PHC under seismic actions directed perpendicular to the longitudinal axes of the workings is under conditions of plane strain and the problem reduces to the two-dimensional problem in elasticity theory for a multiply connected region. The PHC of the Rogun hydrostation is located in the vicinity of the Vakhsh River canyon, and thus it was necessary to take into account the presence of a free surface of complex profile. The work undertook to determine the stresses in linings and interchamber pillars under seismic actions directed perpendicular to the longitudinal axis of the workings. The experiments were conducted for several variants of the direction of wave propagation. Interpretation of the optical patterns consisted in constructing time dependences of the contour stresses on the boundaries of the workings and the sum and difference of the principal stresses. (Baker-IVI)
W84-02647

CONSIDERATION OF THE WORK OF ELASTIC AND INERTIAL FORCES OF THE FOUNDATION WHEN DETERMINING SEISMIC LOADS FOR THE DAM OF THE KURPSAI HYDROELECTRIC STATION,
V. N. Lombardo.
Hydrotechnical Construction, Vol. 17, No. 4, p 156-165, April, 1983. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 16-23, April, 1983.

Descriptors: *Dam construction, *Seismic properties, *Design criteria, Dams, Construction, Elastic properties, Hydroelectric powerplant, Powerplants, Kurpsai Hydroelectric Station.

The problems of considering the work of elastic and inertial forces as applied to the calculations of a section of a gravity dam are considered. The structure and region adjacent to it are considered to work under the conditions of the two dimensional problem in elasticity theory. The inertial load is determined under the condition of rigid restraint along the base and also in cases when the calculation scheme includes a region of the foundation of various dimensions. In order to take into account the work of elastic and inertial forces it is necessary to include in the calculation scheme a region of the foundation of considerable size. With such consideration of the effect of the foundation it is necessary to examine about 100 modes of free oscillations lying in the frequency range of the first four or five modes of oscillation of a cantilever beam. Correct consideration of the work of elastic and inertial forces of the foundation permits reducing the inertial load. With respect to the calculation of the Kurpsai dam this decrease was about 20-30% compared to the load determined by the beam scheme with consideration of elasticity of the foundation by Vogt's method. (Baker-IVI)
W84-02648

ACCURACY OF DETERMINING THE DESIGN VELOCITY IN POWER CONDUITS OF HYDROELECTRIC STATIONS,
V. A. Orlov.
Hydrotechnical Construction, Vol. 17, No. 5, p 213-224, May, 1983. 4 Fig, 3 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 15-20, May, 1983.

Descriptors: *Design criteria, *Conduits, Powerplants, Hydroelectric plants, Velocity, Construction, Water velocity.

A change in the design velocity in power conduits even by a comparatively small amount leads to noticeable changes in capital investments in these structures. This is especially true for long diversion conduits and penstocks. The design velocity in power conduits of hydroelectric stations is determined from the condition of minimum calculated expenditures on the following components: the power conduit, the structures linked to it, the substituting thermal power station, and its fuel resources. With an increase of the velocity in the conduit, the calculated expenditures on the conduit and linking structures decrease and the expenditures on the thermal power station and fuel resources increase. The design water velocity in conduits should be assigned with consideration of the linking structures and possible variation of the calculated expenditures. It is expedient to go for an increase of velocity with consideration of construction works and standard diameters of the conduit. (Baker-IVI)
W84-02653

HYDRAULIC FILLING FOR CLOSING THE CHANNEL OF THE VOLGA AT THE SIDE OF THE CHEBOKSARY HYDROELECTRIC STATION,
N. A. Bychkov, N. K. Golubev, and M. S. Triandafilov.
Hydrotechnical Construction, Vol. 17, No. 5, p 225-231, May, 1983. 6 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 20-24, May, 1983.

Descriptors: *Hydraulic fill, *Channel improvement, Channels, Dams, Cheboksary Hydroelectric Plant, USSR, Volga River, Earth dams, Construction, Rocks.

The use of hydraulic filling for closing the channel of the Volga at the site of the Cheboksary hydrostation showed that high productivity and efficient operation of suction dredges under severe weather conditions is possible with thorough performance of preparatory works on stockpiling soil and clearing construction trash from sections of cofferdams to be excavated. When closing river channels it is necessary to accomplish, as far as possible, maximum narrowing of the channel by hydraulic filling into the flow by dredges, which makes it possible to reduce the use of costly imported materials and to reduce the volume of hydraulic works before the start of the final stage of closing the channel. In the presence of a shuga run, the construction of a channel earth dam should be carried out with negligible lagging of the narrowing of the channel by hydraulic fill over the entire width behind the narrowing of the gap by a berm, with consideration of the volume of works, time of their performance, and selection of the appropriate means of mechanization. (Baker-IVI)
W84-02654

PROTECTION OF THE SLOPES OF EARTH DAMS DURING CONSTRUCTION OF TIDAL POWER STATIONS,
V. G. Yakovenko, and N. A. Tsymarnaya.
Hydrotechnical Construction, Vol. 17, No. 5, p 253-257, May, 1983. 4 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 36-38, May, 1983.

Descriptors: *Earth dams, *Powerplants, *Slope protection, *Tidal powerplants, Dam construction, Construction, Design criteria, Tides, Slopes, Slope stabilization.

Tidal energy is being explored as a potentially economically advantageous source of energy. One characteristic is the constancy of its mean monthly potential in a long-term series. Its considerable presence in the White and Okhotsk Seas and also the favorable experience of new designs tested during the construction and 14 yr operation of the Kislaya Guba tidal power station made it possible to proceed to the planning of powerful tidal power stations in the Mezen and Penzhina bays and also an experimental tidal power station in the Kola Bay. Progressive new technological equipment has recently come into use in protecting dam slopes in marine hydrotechnical construction in the form of self-elevating platforms whose use when protecting the slopes of dams of a TPS can solve the problem of the continuous construction of revetments under open-sea conditions. Use of such self-elevating platforms is discussed. (Baker-IVI)
W84-02657

TEMPERATURE REGIME AND STATE OF THERMAL STRESS OF THE KURPSAI DAM,
K. I. Dzyuba, and N. I. Fradkina.
Hydrotechnical Construction, Vol. 17, No. 6, p 289-293, June, 1983. 3 Fig, 6 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 11-14, June, 1983.

Descriptors: *Concrete dams, *Thermal stress, Temperature effects, Dams, Dam construction, Thermophysical characteristics, Tensile stresses, Kurpsai Dam, USSR.

For the examined thermophysical characteristics of the concrete and foundation and conditions of con-

structing the Kurpsai Dam, the absence of insulation on the downstream face leads to the occurrence of considerable tensile stresses both in the outside and interior zones of the dam. In this case it should be expected that a disturbance of the solidity in the outer zones of the dam will occur even in the construction period both on the downstream and upstream faces, primarily opening of the block joints which have a low tensile strength of the concrete, which is confirmed by on-site observations conducted during construction of the dam. In the central part of the dam the tensile stresses in the construction period do not exceed the tensile strength of the concrete. In the opening period the horizontal tensile stresses in the interior zones of the dam are close to the tensile strength of the concrete. Under these conditions special attention should be given to providing the specified tensile strength of the concrete to avoid the occurrence of vertical cracks in the middle of the dam. In connection with the low tensile strength of the horizontal block joints considerable vertical tensile stresses occurring in the interior zones of the upper part of the dam in the operating period can lead to their opening. (Baker-IVI)
W84-02661

SOILS AND METHODS OF CONSTRUCTING EARTH DAMS,
A. A. Borovoi, L. P. Mikhailov, I. S. Moiseev, and V. G. Radchenko.
Hydrotechnical Construction, Vol. 17, No. 6, p 333-339, June, 1983. 5 Fig, 1 Tab, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 45-49, June, 1983.

Descriptors: *Earth dams, *Dam construction, Soil properties, Design criteria, Soil types, Strength, Argillite, Siltstone, Shales, Rocks, Regulations, USSR.

Earth dams are becoming increasingly more prevalent in Russia, especially in regions with a harsh climate and in difficult accessible mountainous regions. High earth dams are important engineering structures. The type of earth dam to be built is determined primarily by the presence of soils in the construction region suitable for its construction. For almost any site a dam can be designed with a soil or nonsoil watertight element in which nearby soils could be used, especially with consideration of the fact that the majority of soils, including waterlogged, low-strength, weathered, and even coal-mining wastes, are presently being used. The use of low strength soils from rocks of the type argillite, siltstone, shales and the like in the construction of dams in many cases permits a substantial reduction of their cost and construction time. Field and on-site investigations of the weatherability of low-strength soils showed that no noticeable change in the particle-size distribution occurs in the compacted material under the effect of atmospheric agents. In certain cases the use of waterlogged soils with consideration of the construction of drainage layers is considered expedient for the body of earth dams or cores of rock-earth dams. The maximum allowable settlements of high dams owing to the complexity of joining individual zones with each other and with the base and walls of the canyon are usually limited to control cracking. Limitation of the deformability of cores of high dams necessitates their preliminary preparation by enrichment, mixing of various soils, removal of large stones, drying soils or their additional wetting. Technological methods of constructing dams are constantly being improved. Along with the widely used methods of layer-by-layer construction of dams by means of hydraulicking, placing soil in water and construction by directed blasting is promising. (Baker-IVI)
W84-02665

ENGINEERING WATER WELLS,
Central Utah Water Conservancy District, Orem.
C. H. Carpenter.
Journal of the American Water Works Association, Vol. 75, No. 8, p 395-397, August, 1983. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Wells, *Construction, Decision making, Planning, Design criteria, Energy, Costs, Financial aspects, Test wells.

Groundwater users should seek to obtain the most efficient wells possible by means of hydrogeologic investigations as energy costs continue to rise. Applied engineering and investment in a test hole provide the best possible design for a satisfactory and long term water well that will produce satisfactory quantities of water with minimal operating costs. Applied engineering and investment in a test hole provide the best possible design for a satisfactory and long term water well. First, a thorough geohydrologic study is made to locate the best site. Then the services of an engineer are sought to design the well properly. After the well is constructed and properly developed, a pumping test is conducted to determine long term performance and to design the pump. The basic objective in water well construction is to maximize the opening to allow water to flow from the water bearing formation to the pump and still retain the formation material outside the casing of the well. It is noted, however, that no matter how much geohydrology goes into well location or how much engineering is provided to design water wells, successful wells still depend to a large extent on the skill of the well driller. (Baker-IVI)
W84-02668

ENERGY EFFICIENCY THROUGH PIPE DESIGN,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski.
Journal of the American Water Works Association, Vol. 75, No. 10, p 492-495, October, 1983. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Pipelines, *Economic aspects, *Decision making, Planning, Management, Water supply, Design criteria.

Some simple rules that incorporate energy cost factors into the selection of pipe sizes during development of planning studies are presented. The correct way of determining optimal pipe size is to choose several candidate pipe sizes, to calculate pumping and energy requirements for each size based on peak flow, to determine actual flows during the life of the pipe, to determine system head curves and pump characteristic curves, and then to compare the life-cycle costs of various pipe sizes. The final selection is an economic one of minimizing life cycle costs while meeting the needs of the system under study, including environmental, legal, fiscal, and institutional constraints. The amount of data needed includes flows (peak, average, and minimum), length of pipe, elevations, required heads, pipe type, energy costs, labor rate, interest rate, design life, number of pumps, depth of cover, and amount of excavation occurring in rock. (Baker-IVI)
W84-02674

COMPARISON OF 2-D AND 3-D DYNAMIC ANALYSES OF EARTH DAMS,
Harding-Lawson Associates, Novato, CA.
L. H. Mejia, and H. B. Seed.
Journal of Geotechnical Engineering, Vol. 109, No. 11, p 1383-1398, November, 1983. 12 Fig, 17 Ref. NSF grant PFR-7918267.

Descriptors: *Dynamic response analysis, *Earth dams, Stress analysis, Rheology, Dynamic stress, Shear stress, Plane strain, Two-dimensional models, Three-dimensional models, Earthquakes, Oroville dam.

Considerable judgment is required to estimate the overall three-dimensional dynamic response to a dam in a narrow canyon from plane strain analyses of individual sections of the dam. Three-dimensional and two-dimensional dynamic analyses of two dams with different canyon geometries are compared. Oroville Dam and a hypothetical dam with the same main section as Oroville Dam but in a narrower canyon are the focus of the analyses. The plane strain analysis of the maximum section of Oroville Dam have values for the shear stresses that were within 20% of those computed from a three-dimensional analysis of the dam. Accelerations were found to be more sensitive to the boundary conditions and, therefore, less accurately computed from a two-dimensional analysis than stresses. Similar conclusions were made in regard to the plane strain analysis of the quarter section of the dam. For dams in steeper canyons than that of Oroville Dam, plane strain analyses of the maximum section and the quarter section of the dam apparently cannot simulate correctly the behavior of the embankment. It is necessary in those cases to perform three-dimensional analysis to obtain satisfactory results for design purposes. (Murphy-IVI)
W84-02825

IMPROVED RISK AND RELIABILITY MODEL FOR HYDRAULIC STRUCTURES,
Texas Univ. at Austin. Dept. of Civil Engineering.
H.-L. Lee, and L. W. Mays.
Water Resources Research, Vol. 19, No. 6, p 1415-1422, December, 1983. 11 Fig, 16 Ref.

Descriptors: *Hydraulic structures, *Model studies, Construction, Risks, Decision making, Planning, Water management, Water resources development, Economic aspects.

Improved dynamic risk and reliability models based on conditional probability distributions are developed. The new dynamic risk model reflects more accurately the overall risk (probability of failure considering both hydrologic and hydraulic uncertainties) of a hydraulic structure. This dynamic risk model is also shown to have a close correspondence to nonparametric methods for evaluating the exceedance probability of a hydrologic event. Generally the return period of a flood with certain magnitude for the design criteria is not known exactly. The time period estimated from the limited sample observations might lead to a biased estimate for the return period of such a flood. The new dynamic risk model can lead to the improved design of flood prevention measures. The risk models developed can be applied to other types of hydraulic structures, such as bridges, storm sewers, and channels. (Baker-IVI)
W84-02845

WATER SUPPLY SYSTEM DESIGN INVOLVES MANY TECHNOLOGIES,
Burns and McDonnell, Kansas City, MO.
R. D. Vering, D. J. Langford, and K. M. Neuschwander.
Power Engineering, Vol. 87, No. 12, p 44-46, December, 1983.

Descriptors: *Water conveyance, *Design criteria, Powerplants, Pipelines, Reservoirs, Pumps, Valves, Utah, Green River, Cooling water, Corrosion control, Water hammer.

An 800-MW power plant was planned for construction in Utah at a point 20 miles to the southeast of the Green River, which was to serve as the major source of water for the plant. A single pipeline was designed to supply the water needs. Maximum plant demand has been projected to be 27 cu ft/sec based on the plant's two-unit evaporative wet cooling tower needs. Surface-type diversion method could not be used because of severe environmental problems and river characteristics which included low gradient, heavy sediment load, migrating channel and sand bars, shallow depth, and winter icing problems. Pumping scheme selection was of primary importance because of the need to lift the water more than 1000 ft from the Green River to a high-point reservoir. System control complexity was reduced by using two reservoirs to accommodate flow variations and provide capacity to allow for reaction time during a system upset. Flow in the gravity-flow line portion of the pipeline is controlled by discharge control valves installed at the bottom of the downhill line. The problem of water hammer was analyzed and controlled. Impressed current corrosion as well as galvanic corrosion were major design considerations and several steps were taken to enhance the corrosion resistance capabilities of the water supply line. Concrete pipe joints were bonded to provide electrical continuity. (Baker-IVI)
W84-02904

8B. Hydraulics

CHARACTERISTICS OF A STUDY OF THE PHYSICAL AND MECHANICAL PROPERTIES OF MEALY DOLOMITES IN HYDROTECHNICAL CONSTRUCTION,

N. F. Aripov, S. V. Bortkevich, and A. N. Skibin.

Hydrotechnical Construction, Vol. 17, No. 4, p 166-171, April, 1983. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 23-26, April, 1983.

Descriptors: *Dolomite, *Physical properties, *Dam construction, Earth dams, Construction, Soil engineering, Soil properties, Soil compaction.

The compressibility of the soil by static loads under drained conditions was estimated using a cylindrical press mold with a cross-sectional area of 40 sq cm at various water contents. Soil strength was studied in direct and triaxial shear apparatus on cylindrical specimens with a cross-sectional area of 40 sq cm. An essential characteristic of mealy dolomites is the rapid realization of settlement during loading, which makes them similar to sands. When studying the properties of mealy dolomites as a material of earth dams and embankments of hydraulic structures it is necessary to take into consideration that the structure of the artificially compressed dolomite soil has a substantial effect on its physical and mechanical characteristics. Dolomite soil compressed with a water content higher than the optimal has a mobil structure, promoting an increase of its compressibility and self-strengthening in shear due to repacking of the mineral particles. The difference in the structures and deformation properties of saturated dolomitic soil compressed at an optimal water content and water content higher than the optimal is observed in the range of values of the unit dry weight 1500-1950 kg/cu m, beyond the limits of which they become the same. (Baker-IVI)
W84-02649

HYDRAULIC RESISTANCES AND OPTIMAL DIMENSIONS OF STREAMFLOW DIVERSION CANALS,

I. F. Karasev.

Hydrotechnical Construction, Vol. 17, No. 4, p 175-180, April, 1983. 2 Fig, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 29-33, April, 1983.

Descriptors: *Hydraulic properties, *Canals, *Streamflow, Design criteria, Resistance, Diversion canals.

Additional theoretical and empirical substantiations of the calculated hydraulic relations of artificial canals are needed with consideration of a set of factors determining the capacity of large canals. The dependence of resistance on the channel form factor b has been known for a long time, but its quantitative estimates are quite contradictory. To take into account the relative width factor one of the integral laws of hydrodynamics, the momentum theorem, has been applied to the usual hydraulic schematization of a flow with main dimensions R and specific wetted perimeter. For conditions of large canals it appears that the loss of dynamic stability of the flow is accompanied by reorganization of its kinematic structure and channel morphology. Two zones of maximum velocity appear in the cross section - a sign of integral separation of the flow into macrojets. The bottom relief also undergoes a change. Instead of a more or less ordered system of ribbon ridges, barchan-type ridges form. A relation is observed between the form parameters and the steepness of the ridges. Under certain conditions the ridge formations take the form of dunes, inducing the channel to meander. A shift of the channel line creates zones of pressing of the flow toward the banks and centers of their erosion, supplying the flow with sediments, which activates still more the side erosion process that occurred. Deformation can take on a progressive uncontrollable character, if engineering measures limiting its development are not provided for. (Baker-IVI)
W84-02650

CAUSES OF RIVER BED DEGRADATION,

V. J. Galay.

Water Resources Research, Vol. 19, No. 5, p 1057-1090, October, 1983. 44 Fig, 3 Tab, 77 Ref.

Descriptors: *Bed degradation, *River beds, River slope, Flow discharge, Bed material, Control points, Tributaries, Upstream, Downstream, Flood damage.

River bed degradation can proceed downstream as well as upstream depending upon the cause of degradation. The causes of downstream progressing degradation are primarily related to changes in independent river channel variables, such as increase in water discharge, decrease in size of bed material, and decrease in bed material discharge. Upstream progressing degradation is generally caused by an imposed increase in river slope, which may be achieved by lowering a base level, such as in a lake or main river, or by decreasing the river length by removing a control point. Upstream progressing degradation, in general, develops more quickly than downstream progressing degradation. Downstream and upstream progressing degradation may occur within the same river reach at the same time. Any type of degradation on a main river generally produces upstream progressing degradation on a tributary. The degradation of the tributary can interfere with the degradation process on the main river. Degradation can occur very rapidly, within one flood event, and can proceed for many kilometers up or down a river. The design of water resource projects should include a careful analysis of all possible degradation processes along the main river, as well as along major tributaries. (Moore-IVI)
W84-02753

INFLUENCE OF THE POINT BAR ON FLOW THROUGH CURVED CHANNELS,

W. E. Dietrich, and J. D. Smith.

Water Resources Research, Vol. 19, No. 5, p 1173-1192, October, 1983. 20 Fig, 2 Tab, 50 Ref.

Descriptors: *Point bars, *Channel flow, *Channel curves, Shoaling, Flow velocity, Shear stress, Meanders, Cross-stream flow, Boundary conditions, Flow acceleration, Bottom topography, Water surface slope.

In a channel with bed topography that does not vary in the downstream direction, a secondary circulation composed of outward flow at the surface and inward flow near the bottom extends across the entire width. If the curvature is constant, the cross-stream velocity component near the bed and the pattern of boundary shear stress can be estimated by assuming fluid accelerations to be small. Unfortunately, this procedure cannot be used in analyzing the flow through natural river meanders, or through channels with downstream constant bottom topography but with rapidly changing curvature. In these latter cases, effects arising from bed- and bank-induced momentum changes must be accounted for. Evidence for a substantial topographically induced alteration in the cross-stream flow pattern relative to that for the analogous constant bottom topography case is provided through new analyses of several sets of laboratory and field data. Shoaling over the point bar in the upstream part of the bend is shown to force the high-velocity core of the flow toward the pool. This is accomplished by a convective acceleration-caused decrease in the cross-stream water surface slope and a resulting dominance of the vertically averaged centrifugal force. The primary effect is a velocity component toward the outside or concave bank throughout the flow depth over the upstream, shallow part of the point bar and an outward component of boundary shear stress in this region. The channel curvature-induced inward component of boundary shear stress consequently is confined to 20 or 30% of the channel width at the pool. Outward transfer of momentum over the point bar, as manifested by a rapid crossing of the high-velocity core from the inside bank to the outside one, contributes to an enhanced decrease in boundary shear stress along the convex side of the stream as the top of the bar is approached. Forces arising from topographically induced spatial accelerations are of the same order of magnitude as the downstream boundary shear stress and water surface slope force components, so they must be modeled as zero-order, not first- or second-order, effects. (Author's abstract)
W84-02762

LINING TUNNELS: TOUGHEST CONCRETING JOB.

Civil Engineering, Vol. 53, No. 11, p 60-61, November, 1983. 1 Fig.

Descriptors: *Concrete, *Tunnels, *Construction, Linings, Tunnel linings, Design criteria, Water conveyance, Water distribution, New York City.

The newest water supply tunnel in New York City is being constructed with exceptionally careful inspection and testing to be sure specifications are met. The lining of the 24 ft diameter tunnel was cast at least 17 in thick. Three shifts placed an average of 700 cu yd per pouring day. The lining was placed in two phases. First, the invert was poured in sections using a screed forming system that was supported and moved from a trolley system suspended from the tunnel roof. In the second pass, 290 degrees of arch and sidewall were concreted using collapsible telescopic forms moved by a traveler riding on the invert. A team of 10 inspectors worked at the drophole and near the batch plant. There were another 10 inspectors in the tunnel. The tunnel is expected to remain watertight for up to 100 years. (Baker-IVI)
W84-02775

FACTORS IN STABILITY OF RELOCATED CHANNELS,

Geological Survey, Menlo Park, CA.
J. C. Brice.

Journal of Hydraulic Engineering, Vol. 109, No. 10, p 1298-1313, October, 1983. 6 Fig, 27 Ref.

Descriptors: *Channel relocation, *Highways, *Bank stability, Channel stability, Check dams, Channel slope, Erosion, Floods, Vegetation.

Channels are relocated by highway agencies to improve channel alinement at a bridge crossing, to accomodate a planned roadway location, or to avoid one or more crossings. Lateral and vertical stability are assessed for 100 unlined channels, in different parts of the United States, that were relocated by highway agencies 10 years or more before assessment. Median length of natural channel cut off by relocation is 50 times natural channel width, or about 2,100 ft (650 m). Of all the relocated channels, banks are assessed as stable at 78% and unstable at 22%; of the shorter relocated channels (less than 50 channel widths), banks are assessed as stable at 84% and no significant degradation was observed. Of the unlined alluvial channels without check dams or bedrock outcrops (70 sites), 6% showed evidence of degradation to a depth of less than 1.5 ft (0.5 m). Of the 17 sites with check dams, 35% showed evidence of degradation, to maximum depths in the range of 1-3 ft (0.3-1 m). After an initial period of adjustment, the relocated channels tend to have about the same stability as that of the prior natural channel. Most of the relocated channels are shorter than their corresponding segments of natural channel by factors ranging from 0.1-0.9, and their slopes are therefore greater. Increase in channel slope by relocation is not clearly related to instability; and stable channels of similar drainage area range widely in slope. Factors commonly associated with instability are: bends in channel; erodibility of bed-bank materials; floods of large recurrence interval; and instability of natural channel before relocation. Factors associated with channel stability are side slopes not greater than 2:1, check dams, growth of woody vegetation on banks, straightness of alinement, erosional resistance of bed-bank materials, and natural (or artificial regulation of discharge. (Moore-IVI)
W84-02865

MEANDER BENDS OF HIGH AMPLITUDE,

Minnesota Univ., Minneapolis.
G. Parker, P. Diplas, and J. Akiyama.

Journal of Hydraulic Enginering, Vol. 109, No. 10, p 1323-1337, October, 1983. 15 Fig, 19 Ref. NSF grant CEE 8204953.

Descriptors: *Meanders, *Alluvial rivers, *Bends, Mathematical equations, Amplitude, Kinematics, Bank erosion, Skewing.

Meander bends of high amplitude in alluvial rivers often display a high degree of coherency. The only analytical equation heretofore available to describe such bends is the sine-generated curve, which has no rigorous derivation in the context of rivers. Herein a nonlinear 'bend equation,' based on a dynamical description of flow in bends and a kinematical description of bank erosion, is used to describe channel migration. This equation admits solutions of constant amplitude that migrate downstream with constant speed. The solution at high amplitude displays a prominent skewing that reveals the direction of flow. At low amplitude, the solution reduces to the sine-generated curve. (Author's abstract)
W84-02867

TRANSIENT CAVITATING PIPE FLOW,
Michigan Univ., Ann Arbor.
V. L. Streeter.
Journal of Hydraulic Engineering, Vol. 109, No. 11, p 1408-1423, November, 1983. 14 Fig, 9 Ref. NSF grant 019974.

Descriptors: *Cavitation, *Fluid mechanics, *Pipe flow, Vapor pressure, Rarefaction wave, Vapor formation, Vaporous velocity, Shock fronts, Mathematical equations.

When a liquid column in a pipeline is pulled apart by the upstream velocity being less than the downstream velocity for a sufficient period of time, cavitating flow occurs over portions of the pipeline. The cavitating flow, with vapor pressure at its surface, is acted on by friction and by gravity (for sloping pipes). A method of calculating transient cavitating pipe flow is developed which attempts to follow the mechanics in a distributed fashion. The manner in which a rarefaction wave moves through the fluid causing vapor formation is described, and equations are developed for vaporous velocity and vapor fraction as functions of distance and time. The vaporous flow is consolidated by shock fronts of liquid at the vapor-liquid interfaces. Equations are developed to determine the speed of the shock fronts and the pressure rise across them. For those reaches having no vapor, the method of specified time intervals within the method of characteristics is utilized. A program which includes these concepts permits transients in piping systems to be calculated for several boundary conditions. The regular method of characteristics gives good results, with only the problem of determining whether the spikes are mathematical or real. (Moore-IVI)
W84-02869

COMPUTATION OF 3-D FLOW AND SHEAR IN OPEN CHANNELS,
Pittsburgh Univ., PA.
C.-L. Chiu, and G.-F. Lin.
Journal of Hydraulic Engineering, Vol. 109, No. 11, p 1424-1440, November, 1983. 8 Fig, 1 Tab, 7 Ref. NSF grant CEE 81-09440.

Descriptors: *Open-channel flow, *Flow velocity, *Shear stress, Mathematical models, Simulation, Spatial distribution, Hydraulic models.

A mathematical modeling technique is presented which is capable of simulating various patterns of primary flow velocity distribution which may have the point of maximum velocity on or below the water surface. The simulated primary flow isovels are then used as a coordinate system in hydrodynamic analysis, to develop equations to compute corresponding distributions of shear stress and secondary flow. The mathematical models developed can be used to determine interactions among the primary flow velocity, shear stress and secondary flow velocity which all have a three-dimensional distribution. The approach is essentially semi-empirical which uses a measured or simulated distribution of primary flow velocity. It is designed to facilitate practical applications in studying various process in open channels, such as diffusion and dispersion of sediment, local scour and deposit, bank erosion, changes in channel geometry, aggradation and degradation of channel bed, which require three-dimensional modelings. An application to a flow in a bend of a laboratory flume has shown that results of simulating the distributions of primary flow velocity and shear stress agree well with the measured data. Large discrepancies are found to exist between the computed and measured secondary flow velocities. However, it is still uncertain whether the discrepancies are entirely due to modeling and computational errors as the accuracy level of measured data is unknown. (Author's abstract)
W84-02870

APPROACH-FLOW EFFECTS ON DOWNPULL OF GATES,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
N. D. Thang, and E. Naudascher.
Journal of Hydraulic Engineering, Vol. 109, No. 11, p 1521-1539, November, 1983. 11 Fig, 1 Tab, 23 Ref, 2 Append.

Descriptors: *Approach flow, *Downpull, *Intake gates, Turbulence, Flow discharge, Flow around objects, Drag, Lift, Hydraulic models.

The effects of various approach-flow conditions upon the downpull, the local pressures, and the discharge characteristics have been investigated for intake gates. Laser-Doppler-Anemometry measurements near the separation point of the gate bottom permit detailed specification of turbulence conditions. The partly strong variation of downpull and discharge coefficient for the different approach flows considered is traced to the sensitivity of the separated-flow pattern near bluff bodies to freestream turbulence, and to changes in the mean-flow incidence. For the particular gate studied, local flow separation from a protruding bottom girder and the placement of a trash-rack-like grid at a short distance upstream from the gate are shown to yield opposite effects on the downpull coefficient as compared to mere freestream turbulence. In analogy to the observations of flows around prisms, two separated-flow regimes with and without reattachment are identified in the flow aroud the gate bottom, and the observed effects of turbulence on the downpull and discharge are interpreted in terms of changes in the separation patterns. The results can be generalized and applied to geometrical configurations other than those studied. (Author's abstract)
W84-02871

ASYMMETRIC PLANE FLOW WITH APPLICATION TO ICE JAMS,
Iowa Univ., Iowa City.
J.-C. Tatinclaux, and M. Gogus.
Journal of Hydraulic Engineering, Vol. 109, No. 11, p 1540-1554, November, 1983. 6 Fig, 1 Tab, 17 Ref, 2 Append. NSF grant CME 77-12176.

Descriptors: *Ice jams, *Plane flow, Turbulence, Flow velocity, Shear stress, Simulation, Mathematical equations, Friction, Roughness.

An available turbulence method is used to prove that in plane flows between two boundaries with asymmetric roughness the plane of maximum velocity is not the plane of zero shear stress. By dividing the flow at the plane of zero shear stress, laboratory and field data on flows below simulated and actual ice jams are analyzed to derive equations for the boundaries' friction factors in terms of mean flow velocity, depth of flow zone, and boundary roughness for smooth and fully rough boundaries. These equations are applied to the calculations of ice jam characteristics. For the jams studied, the present method gives a variation of about 10% in the jam characteristics with a method based on dividing the flow at the plant of maximum velocity. (Author's abstract)
W84-02872

COMPARISON OF OPEN CHANNEL CONSTRICTION RATINGS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
A. A. Fiuzat, and G. V. Skogerboe.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1589-1602, December, 1983. 1 Fig, 11 Tab, 9 Ref, 2 Append.

Descriptors: *Backwater, *Open-channel flow, *Submerged flow method, *Channel constrictions, Flow discharge, Bridges.

The problem of calculating the discharge through, or the backwater due to, open channel constrictions has been a research endeavor involving hyudraulic engineers for many decades. Most of the effort so far has been concentrated on laboratory data involving prismatic flumes, and less work has been done in collecting actual field data involving larger structures such as bridges. However, accurate discharge and backwater relationships are required based on laboratory data in order to expedite the calibration of larger field structures. The submerged flow method provides a promising approach for calculating the discharge or the backwater due to open channel constrictions. Two sets of data collected in two independent laboratory studies were utilized to compare the submerged flow method to other methods. The first set was used to calibrate the submerged flow equation, while the second set was utilized to verify the calibrations. The submerged flow equation was compared with other methods suggested for the same set of data by earlier investigators. The results showed very consistent discharge estimation by the submerged flow method. The submerged flow method is more versatile in application to design where the flow rate is know and the accompanying backwater due to a constriction is to be determined. (Moore-IVI)
W84-02874

SIDE DISCHARGES INTO OPEN CHANNELS: MATHEMATICAL MODEL,
Karlsruhe Univ. (Germany, F.R.). Sonderforschungsbereich 80.
A. O. Demuren, and W. Rodi.
Journal of Hydraulic Engineering, Vol. 109, No. 12, p 1707-1722, December, 1983. 12 Fig, 1 Tab, 22 Ref, 2 Append.

Descriptors: *Entrainment, *Side discharges, *Wastewater disposal, Effluents, Cooling water, Mathematical models, Open-channel flow, Turbulence, Jets.

Wastewater from sewerage treatment plants, or once-through-cooling thermal power plants, is often ejected through side discharges into rivers over the full depth. If the wastewater jet is discharged at moderate rates relative to the river discharge, it entrains ambient fluid on both the upstream and the lee side. The river flow is diverted by the jet towards the far bank, while the jet itself is deflected in the river flow direction. A three-dimensional numerical mathematical model for calculating the near field of side discharges into open channel flow is presented. The method employs the standard k-e turbulence model for determining the turbulent stresses. Two discretization schemes are considered, namely, the hybrid central/upwind differencing scheme and the quadratic, upstream-weighted differencing scheme. The latter produces improved numerical solutions for a number of recirculating flows. The predictions are compared with experimental observations of earlier investigators of isothermal side discharges into both rough- and smooth-bed open channel flows; each at discharge to cross flow velocity ratios of 0.3 and 4.0. The agreement is, in the main, satisfactory for all the different cases considered. Now that the 3D model has been found to perform well for isothermal discharges, and the need for employing a higher-order numerical scheme has been established, it can be extended for calculating heated discharges by introducing buoyancy terms into both the mean-flow and turbulence-model equations. (Moore-IVI)
W84-02880

Group 8B—Hydraulics

ANALYSIS OF RIVER MEANDERS,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 110, No. 1, p 37-50, January, 1984. 5 Fig, 1 Tab, 29 Ref, 2 Append.

Descriptors: *Meanders, *Sediment load, *Channel slope, Curvature, River flow, Energy gradient, Bed slope.

The meander curvature and other geometric features for rivers are analyzed using an energy approach together with relations for flow continuity, sediment load, resistance to flow, bank stability, and transverse circulation in channel bends. Geometric variables of meanders are obtained so that the inflow water discharge and sediment load for the watershed are transported with minimum power expenditure per unit channel length and equal power along the reach. Minimum power also means minimum channel slope or energy gradient for the given conditions. The water and sediment inflow, which are determined in the watershed, are such that the channel slope so produced is usually different from the valley slope. Meander develops so that a river with a flatter slope can exist on the valley slope. The analysis establishes the maximum curvature for which a river does the least work in turning. This curvature, stated as the radius of curvature to channel width ratio, has an average value of 3; it shows only minor variation within the meandering range. Meandering represents a degree of adjustment for rivers. A meander curvature increases the power expenditure due to secondary currents, but this is matched by a compensating increase in the sediment efficiency associated with the transverse bed slope. Thus, uniform utilization of power and sediment continuity are maintained throughout the river reach. (Moore-IVI)
W84-02881

8C. Hydraulic Machinery

HYDROELECTRIC GENERATORS WITH A REMOVABLE ROTOR CORE,
B. N. Vasil'ev, V. A. Linyuchev, and N. A. Filatov.
Hydrotechnical Construction, Vol. 17, No. 3, p 209-212, May, 1983. 1 Fig, 2 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 13-14, May, 1983.

Descriptors: *Electrical equipment, *Hydroelectric plants, Turbines, Design criteria, Kegum hydrostation, USSR, Daugave River.

In the USSR the first experience of using a removable rotor core (RRC) was gained while expanding the Kegum hydrostation on the Daugave River, where three 64-MW units with a 9.3 m-diameter Kaplan turbine were installed in a new powerhouse. The use of the RRC made it possible to dispense with one of the two originally planned 250-ton semigantry cranes. Preliminary calculations showed that the use of the RRC for such units is economically justified up to the installation of six units. These calculations took into account that the one-time saving due to reducing the capacity of the cranes is offset by an increase in the cost of assembling each unit with a RRC. For conditions of the Kegum hydrostation the total calculated saving was about 200,000 rubles. (Baker-IVI)
W84-02652

8D. Soil Mechanics

DETERMINATION OF THE ADDITIONAL EARTH PRESSURE ON THE CHAMBER WALLS OF TWIN LOCKS,
A. B. Moshkov.
Hydrotechnical Construction, Vol. 17, No. 4, p 181-190, April, 1983. 6 Fig, 11 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 42-47, April, 1983.

Descriptors: *Earth pressure, *Locks, Earth dams, Votkinsk Lock, Pressure, Soil properties, Construction, Standards.

During comprehensive on-site observations of the working of the Votkinsk lock in May and June of 1964, it was discovered that there was an effect of pressure from the lock chamber being filled transmitted through the soil in the interlock space to the adjacent lock. During filling of one of the twin lock chambers possessing a small width of interlock space, the relatively flexible wall of the chamber being filled, bent toward the backfill, compressing the soil filling this space to such a degree that it began to press the wall of the adjacent chamber. The instructions of SNiP II-55-79 for determining the additional earth pressure give overestimated values of this pressure, which do not agree with the data of on-site observations. The soil reaction pressure behind the outer walls of the chamber being filled from their bending by the water determined for the case of controlled backfill is underestimated. When calculating chambers of twin locks for hydrostatic loads it is recommended that the soil reaction pressure behind both walls of the chamber being filled be determined by means of calculation schemes used for single land locks. The additional earth pressure being transmitted through the backfill of the interlock space to the adjacent chamber should be determined in fractions of this reaction pressure by relations which are given. In calculations of the strength of lock chambers it is suggested that the shear stresses be taken into account on the contact of the soil with the backs of the walls. This will make it possible to reduce the calculated area of reinforcement. Furthermore, consideration of friction forces in calculations for the hydrostatic load will permit using lower levels of backfill behind the chamber walls, which will ease their work and permit designing more economical structures. (Baker-IVI)
W84-02651

EARTH REINFORCED DAMS: FIRST IN U.S.
Civil Engineering, Vol. 53, No. 10, p 60-63, October, 1983. 1 Fig.

Descriptors: *Dam construction, *Earth dams, Reinforced earth, Texas, Colorado, Montana, Austin, Design criteria, Costs.

Earth reinforcement for dam restoration and construction have brought an average dollar savings of as much as 30% compared to other design alternatives. A patented product, Reinforced Earth provides a means of improving the mechanical properties of basic material, earth, by reinforcing it with metal strips. The galvanized steel strips reinforce the earthfill in the directions in which it is subject to the greatest stresses. The backfill is essentially granular, composed of sand, gravel or crushed stone. A facing prevents erosion of the backfill and provides a finished surface. Design considerations are dictated by site requirements. In building the Woodhollow Dam, the City of Austin, Texas, faced space constraints and public pressure to build an attractive structure. The 344 ft long water storage and flood control dam was built between two large apartment complexes. The first reconstruction project in the United States using reinforced earth was for a deteriorating 110 yr old stone masonry dam in Jamesville, NY. Similar work has been investigated for the Lake Sherburne Dam in Montana, and the Taylor Draw Dam in Colorado. (Baker-IVI)
W84-02773

8E. Rock Mechanics and Geology

GEOTECHNICAL ASPECTS OF THE KIELDER DAM,
J. P. Millmore, and R. McNicol.
Proceedings of the Institution of Civil Engineers, Vol. 74, Part 1, p 805-836, November, 1983. 23 Fig, 11 Tab, 11 Ref.

Descriptors: *Dams, *Geology, *Embankments, *Kielder Dam, River North Tyne, England, Seepage, Reservoirs, Interstitial water, Dam design.

Kielder Dam on the River North Tyne (England) was constructed between 1976 and 1982 and forms Kielder Water, an impounding reservoir with 188,000,000 cu m usable storage. Since completion of construction and impounding, movements measured in the dam have been very small. Pore-water pressures in the embankment appear to be stabilizing, although long term steady-state seepage through the dam has yet to be established. Monitoring to date shows that the present underseepage is less than the various predictions and justifies the controlled underseepage design philosophy adopted for the dam. There can be no doubt that extensive materials testing ensured a dam of known characteristics which gave confidence in the design used; instrumentation monitoring of movement and pressure permitted stability assessments to be made on a continuous basis. Future recording of selected instruments will ensure an understanding of the behavior of the dam in service. Rapid construction of the embankment dictated close control of the fill materials and the monitoring of pressures and deformations, which revealed the need for two stability berms. (Baker-IVI)
W84-02507

CHARACTERISTICS OF THE MECHANICAL PROPERTIES OF ROCKS,
T. F. Lipovetskaya.
Hydrotechnical Construction, Vol. 17, No. 6, p 281-282, June, 1983. 1 Fig. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 6, p 6, June, 1983.

Descriptors: *Rock properties, *Dam construction, Earth dams, Rocks, Soil properties, Construction, Nurek dam, Strength.

When substantiating the designs of earth dams, especially when designing high and very high dams in seismic regions, the calculated values of the strength characteristics of the soils composing them have decisive importance. The methods of determining the calculated values of the characteristics of soil strength from the results of experimental investigations are standardized by construction specifications and regulations SNiP II-16-76. If the values of the strength characteristics obtained in conformity with the requirements of this standard were used in the calculations, dams could be designed of a sufficiently compressed profile. (Baker-IVI)
W84-02658

RELIABILITY OF ROCK FOUNDATIONS OF CONCRETE DAMS,
E. S. Kalustyan.
Hydrotechnical Construction, Vol. 17, No. 6, p 282-285, June, 1983. 1 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 7-8, June, 1983.

Descriptors: *Dam failure, *Rock properties, *Foundation rocks, Dam construction, Design criteria, Filling, Foundation failure, Earthquakes, Floods, Seepage, Water pressure.

Many factors influence the reliability of rock foundations in dams including the action on the structure of water pressure during filling of the reservoir, floods greater than the design probability, earthquakes, typhoons, climatic factors, and the environment. The structure itself is also a factor, including the dam, and the foundation. Destruction of the foundation under the action of the external medium (EM), by which is meant the action of water pressure during filling always leads to failure of the entire system, and the failure of the dam involves the destruction of the foundation. The majority of failures and damages of dams on a rock foundation (64.8%) occurred during filling of the reservoir, which made it possible to detect defects of the dam or foundation. The second cause in relation to significance is flow over the dam as a result of the passage of floods below the design probability (27.8%). Earthquakes and climatic factors gave 5.6 and 1.6%, respectively. The significance of earthquakes, however, should not be underestimated in connection with construction in regions of tectonic activity. The greatest number of failures and incidents - 34% is related to seepage in the foundation. The hydrostatic pressure of water in 29% of the cases led to shearing, formation of cracks, and displacement of the dams along

the foundation. Cases related to aging of the drainage system and uplift amount to 29% of the cases. The reliability of the constructed structures can be estimated on the basis of the general method of analyzing failures based on the use of a multifactor model. (Baker-IVI)
W84-02659

TEMPERATURE REGIME AND STATE OF THERMAL STRESS OF THE KURPSAI DAM,
For primary bibliographic entry see Field 8A.
W84-02661

8F. Concrete

TEMPERATURE REGIME OF THE CONCRETE DAM ON THE KURPSAI HYDROELECTRIC STATION DURING THE CONSTRUCTION PERIOD,
A. I. Tsarev, M. S. Kazachenko, and A. B. Kocharyants.
Hydrotechnical Construction, Vol. 17, No. 6, p 285-288, June, 1983. 4 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 8-10, June, 1983.

Descriptors: *Concrete Dams, *Temperature, *Kurpsai Hydroelectric Station, Concrete, Dam construction, Hydroelectric plants, Powerplants, USSR, Concrete technology.

The climatic conditions of constructing the Kurpsai dam caused stringent demands on the temperature regime of the concrete during its placement and hardening, which amounted to restricting exothermic heating to 26 degrees C in the rock contact zone and 30 degrees C in the other parts of the structure and limiting the temperature in the direction from the foundation to the crest to 9 to 13 degrees and the core-face temperature difference to 20 degrees. The temperature regime of the concrete was observed by means of embedded string- and semiconductor-type temperature transducers placed at 13 levels with a spacing heightwise from 2 to 9 m. The temperature regime of the dam was found to meet the design and technical requirements imposed on concreting operations. Two characteristic zones of the temperature state of the concrete are noted in the Kurpsai dam: a central zone where the temperature stays at the level of 23 to 24.5 degrees C and is slowly decreasing at a rate of 1 to 1.5 degrees/year; and an outside zone of the dam at a depth of 6-7 m where the temperature regime depends on seasonal variations of the air temperature. Surface watering is an effective means of reducing temperature of the concrete at an early stage of its hardening. (Baker-IVI)
W84-02660

EFFECT OF AUTOGENOUS HEALING OF CONCRETE SUBJECTED TO PERIODIC FREEZE-THAW CYCLES,
S. S. Sukhotskaya, V. P. Mazhorova, and Yu. N. Terekhin.
Hydrotechnical Construction, Vol. 17, No. 6, p 294-296, June, 1983. 3 Fig, 1 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 14-15, June, 1983.

Descriptors: *Concrete, *Temperature effects, *Freeze-thaw cycle, Autogenous healing, Concrete dams, Dam construction, Elasticity, Concrete technology.

The effect of autogenous healing of concrete on its frost resistance was studied under laboratory conditions on mortar and concrete specimens. The change in the structure of the concrete was evaluated from the results of determining the compressive strength and on the basis of the dynamic modulus of elasticity. During tests with continuous freeze-thaw cycles the values of the indices of the main physical and mechanical properties of the concrete and mortar decreased more rapidly than during tests with breaks. As a result of the healing of the concrete, which is displayed more noticeably in the initial test period, the time of failure of the concrete is considerably postponed. Fracture processes during continuous testing develop with acceleration. A similar regularity is noted for each measured parameter, although with respect to absolute value and character of change a definite difference also exists between them due to the different sensitivity to disturbance of the structure. As a result of the break in testing the concrete specimen's modulus of elasticity (Ed), after 200 cycles, increased from 90 to 95%. After 400 cycles Ed of concrete during discontinuous testing decreased to 91% and after a month's break again reached 95%. At the same time the value of Ed of concrete during continuous testing decreased to 84% by 400 freeze-thaw cycles. By 600 cycles Ed during discontinuous testing was 90%, and Ed of concrete during continuous testing was equal to 80%. (Baker-IVI)
W84-02662

CONSIDERATION OF THE EFFECT OF CONSTRUCTION JOINTS ON THE STRENGTH OF MASSIVE REINFORCED-CONCRETE COMPONENTS,
A. P. Kirillov, V. B. Nikolaev, B. S. Belen'kii, O. D. Rubin, and V. M. Braude.
Hydrotechnical Construction, Vol. 17, No. 6, p 323-329, June, 1983. 2 Fig, 2 Tab, 14 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 33-36, June, 1983.

Descriptors: *Concretes, *Joints, *Reinforced concrete, Concrete dams, Dam construction, Dam design, Costs.

When designing massive reinforced concrete components and their elements it is necessary to consider the presence of construction joints between the blocks. The developed design requirements imposed on elements of massive reinforced-concrete components having construction joints and the method of calculating the strength of inclined sections permit a rational arrangement of the construction joints, ensuring reliability and durability of the structures. A differentiated approach to carrying out measures on the surface of blocks in conformity with the graph presented is offered. The cost effectiveness of using the proposed solutions is expressed in a reduction of the cost of works. The proposed solutions permit an experimental and theoretical evaluation of the state of operating reinforced-concrete components on the basis of the strength of inclined sections in the zone of construction joints, which in certain cases effects a savings due to elimination of costly investigations and repair works. It is expedient to introduce the given suggestions into the standards during their revision with respect to the calculation and design of massive reinforced concrete components and their construction. (Baker-IVI)
W84-02664

LINING TUNNELS: TOUGHEST CONCRETING JOB.
For primary bibliographic entry see Field 8B.
W84-02775

8G. Materials

POSSIBILITY OF FACING THE UPPER STORAGE RESERVOIRS OF PUMPED-STORAGE STATIONS WITH POLYMER FILM MATERIALS,
V. D. Glebov, and V. P. Lysenko.
Hydrotechnical Construction, Vol. 17, No. 5, p 247-250, May, 1983. 2 Fig, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 32-34, May, 1983.

Descriptors: *Reservoirs, *Films, *Polymers, Pumped storage, Construction, Dams, Russia, Design criteria, Soil properties.

Watertight film materials can be used for facing the upper reservoirs of pumped storage stations. Use of such material is expedient not only on the slopes of the dike, but also over the entire area of the reservoir. The main conditions for the successful introduction of film facings on the upper reservoirs are the provision of stability of the faced slopes of the dikes and the development of technological schemes of construction works minimizing the danger of damaging the film. Watertight film structures made in the manner of inclined membranes can be recommended for dikes, and the technological schemes of placing the watertight film elements both on the slopes of the dikes and over the entire area should be planned without travel of the construction mechanisms on the protective layer, by using mechanisms of the elevating-grader type. (Baker-IVI)
W84-02655

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

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Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

QUALITATIVE PROPERTIES OF INTERNAL MOTIONS OF LAKE GENEVA (QUALITATIVE EIGENSCHAFTEN INTERNER BEWEGUNGEN DES GENFERSEES),
Ecole Polytechnique Federale de Lausanne (Switzerland).
V. M. Bohle, and C. Perrinjaquet.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 196-218, October, 1983. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Water quality data, *Hydrologic properties, *Lake Geneva, Water currents, Hydrodynamics, Mathematical models, Model studies, Wind-driven currents, Wind waves, Waves, Internal waves.

The internal motions of the Lake Geneva are classified by means of the quotient 'Q' of the kinetic energies in alongshore and on-/offshore directions. Theoretical values for the frequency depending quotient are estimated for three simple model-geometries. A method of fourier spectral analysis was used which regards the limitations of the data set for the 1977/1978 measurement campaign. The internal motions of the Lake Geneva, as a response to external forcing, are relations of the frequency to the quotient of kinetic energies, which are, depending on the season, the slope and the width of the basin. (Murphy-IVI)
W84-03172

2. WATER CYCLE

2A. General

A MODEL FOR ESTIMATING ONE-MINUTE RAINFALL RATES,
Air Force Geophysics Lab., Hanscom AFB, MA.
P. Tattleman, and K. G. Scharr.
Journal of Climatology and Applied Meteorology, Vol. 22, No. 9, p 1575-1580, September, 1983. 7 Tab, 7 Ref.

Descriptors: *Rainfall, *Model studies, Estimating, Multiple regression analysis, Mathematical models, Temperature effects.

A model for estimating one-minute rainfall rates uses stepwise multiple regression analysis. The model has six regression equations to estimate rates that equal or exceed 0.01, 0.05, 0.10, 0.50, 1.0 and 2.0 percent of the time during a month at a given location. Information required to make the estimates consists of monthly mean temperature, monthly mean precipitation, number of days in the month with precipitation (based on any of three threshold values that define a rainy day), and latitude. The model is not valid when the mean monthly temperature is less than freezing, when there is less than one rainy day in the month, or when a precipitation index is less than 2 mm/day. When there are between one and three rainy days during the month, the model may estimate rates for each of the exceedance levels, which when integrated, indicate a total rainfall two or more times greater than the monthly mean precipitation. Under these circumstances heavy, but infrequent, convective precipitation accounts for just about all of the precipitation in the month. Therefore, the most accurate estimates are for the two or three lowest exceedance levels, and significant rainfall may not occur more often than 0.5% of the month. These possibilities should be considered before accepting rate estimates in arid locations. (Murphy-IVI)
W84-03045

RESEARCH ON WATERSHED HYDROLOGY AT THE UNIVERSITY OF ILLINOIS,
Illinois Univ. at Urbana-Champaign.
B. C. Yen.
Journal of Hydrology, Vol. 68, p 3-17, 1984. 2 Fig, 1 Tab, 49 Ref.

Descriptors: *Research, *Watersheds, *Hydrology, Reviews, Mathematical models, Rainfall-runoff relationships, Statistical analysis.

Research on watershed hydrology at the University of Illinois started in the 1880's with the development of the Talbot waterway formula. In the following 60 years, studies on watershed hydrology were continued at Illinois on a relatively limited local scope. Activities on the subject were considerably expanded after Dr. Ven Te Chow joined the University in 1948. Activities in the lumped system approach, experimental investigation of runoff from rainfall, hydraulic based approach and analyses of spatial and temporal distributions of rainfall for watershed runoff are summarized. (Murphy-IVI)
W84-03333

MODELLING OF HYDROLOGIC PROCESSES IN A SMALL URBANIZED HILLSLOPE BASIN WITH COMMENTS ON THE EFFECTS OF URBANIZATION,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
Y. Ando, K. Musiake, and Y. Takahasi.
Journal of Hydrology, Vol. 68, p 61-63, 1984. 16 Fig, 6 Tab, 3 Ref.

Descriptors: *Hydrologic models, *Urban runoff, *Urbanization, *Urban hydrology, Urban drainage, Urban watersheds, Rainfall, Evaporation, Groundwater movement, Groundwater recharge, Impervious area, Tokyo, Japan.

A clarification of the hydrologic processes was developed, based on a study of a small urbanized experimental basin in the Tama hills in the western suburbs of Tokyo, Japan. Impervious areas such as roofs and roads contribute to direct runoff. Infiltration areas do not contribute to direct runoff. Groundwater flow derives from the unconfined aquifer, and is in proportion to the second power of groundwater storage. Groundwater recharge is in proportion to soil-moisture excess. Evapotranspiration in the infiltration area of the urban basin is the same as that in the infiltration area of the natural basin, but the evaporation in the impervious area of the urban basin occurs to the extent of 2mm accompanied by rainfall. There were also urbanization effects on hydrologic processes. The contributing area to direct runoff is the saturated area for the natural basin, as against the impervious area for the urbanized basin. Urbanization effects on groundwater runoff are relatively small. Decrease in the ratio of the infiltration area to the catchment area, due to urbanization, has a large effect on the groundwater recharge process. Urbanization decreases evapotranspiration. (Murphy-IVI)
W84-03337

RAINFALL-RUNOFF RELATIONSHIPS OF SOME CATCHMENTS WITH KARSTIC GEOMORPHOLOGY UNDER ARID TO SEMI-ARID CONDITIONS,
Ministry of Agriculture, Reclamation and Land Development, Benghazi (Libya). Dept. of Water and Soil.
M. R. de Vera.
Journal of Hydrology, Vol. 68, p 85-93, 1984. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationships, *Karst hydrology, Semiarid climates, Catchments, Arid climates, Mathematical equations, Rainfall intensity, Soil water.

Review of available consultant reports on water resources studies in the northeastern zone of Libya shows that fourteen catchments have good data on rainfall and runoff for analysis, but only eight wadis have sufficient flood data of at least eleven events for linear regression analysis. The prevailing surface geology of practically all the catchments is marly limestone, which is conducive to karstification processes. Since wadi flow is a direct response to rainfall, proper consideration of the other factors that affect runoff would result in a better functional relationship for runoff estimation. Results of regression analysis of rainfall and runoff show that the correlation coefficient ranges from 0.219 to 0.89. This means that 4.8 to 80.3% of the variation in runoff can be accounted for by the regression equation. The qualitative effect of karstification is reflected in the highly variable ratio between rainfall and runoff. The runoff coefficient, which is generally taken as the ratio of runoff to rainfall, should be used with caution for estimating historical or future runoff from catchments with karstic geomorphology, especially under arid to semi-arid conditions. A relationship expressing runoff as a function of rainfall intensity, rainfall duration, antecedent soil moisture, depth of unsaturated zone and degree of karstification should be investigated. (Baker-IVI)
W84-03338

APPLICATION OF ENVIRONMENTAL ISOTOPE TRACERS TO MODELING IN HYDROLOGY,
International Atomic Energy Agency, Vienna (Austria).
T. Dincer, and G. H. Davis.
Journal of Hydrology, Vol. 68, p 95-113, 1984. 11 Fig, 31 Ref.

Descriptors: *Hydrologic models, *Isotopic tracers, Hydrology, Groundwater recharge, Soil water, Evaporation, Climates, Precipitation, Tritium, Deuterium, Oxygen, Lakes, Swamps, Groundwater movement.

Chemical transport models employing the environmental isotopes found in natural waters are now practical due to advancements made in nuclear science and computer development. The most conservative tracers of water known are the heavy isotopes of hydrogen, deuterium and tritium. The heavy stable oxygen isotope, O-18, circulates in tandem with deuterium in the hydrologic cycle. Tritium fallout varies seasonally and annually in a systematic fashion and, due to its property of radioactive decay, is highly useful for dating time of recharge of soil moisture and groundwater. C-14 is valuable for tracing old groundwater due to its relatively long half-life of 5568 yr. However, detailed knowledge of the hydrochemistry of the system is needed for successful modeling. Deuterium and O-18 reflect the temperature at which precipitation condensed. They show pronounced seasonal variability and also the effects of altitude, latitude, distance from the sea, amount of precipitation, history of evaporation, and long-period climatic cycles. Principal areas of application of environmental isotopes to hydrologic modeling have been in soil moisture transport, modeling of mixing and evapotranspiration in large lakes and swamps, glacial-ice movement, groundwater flow, and transport of contaminants in groundwater. (Baker-IVI)
W84-03339

LONG-TERM HYDROLOGIC EVENTS FROM SHORT-TERM RECORDS,
N. Bethlahmy.
Journal of Hydrology, Vol. 68, p 141-148, 1984. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Hydrologic models, *Hydrologic data, *Flood forecasting, Mathematical models, Mathematical analysis, River forecasting, River flow, Flood flow, Low flow.

A new method based on ranks calculates the magnitude of hydrologic events associated with any desired probability. The system utilizes a transformation based on the median that yields positive values less than one. The method is substantiated through internal evidence. This method differs in a unique way from methods that define a distribution and then relate the probability of a variable to its deviation from the mean. Both the variable and its rank (its position in an ordered array) are transformed in an identical fashion. Because the time span N is brief, the hydrologist will normally be concerned with the magnitude of a variable at an extrapolated time T that is greater than sampling time N. As a result, n sub T for floods is always smaller than n sub N, and consequently q sub T will always exceed q sub N. If an extraordinarily large flood occurs during the base period N, then

extrapolated flood will be even larger. The reverse would occur for low flows. (Muphy-IVI)
W84-03340

STOCHASTIC NATURE OF OUTPUTS FROM CONCEPTUAL RESERVOIR MODEL CASCADES,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
T. E. Unny, and Karmeshu.
Journal of Hydrology, Vol. 68, p 161-180, 1984. 2 Tab, 14 Ref.

Descriptors: *Stochastic process, *Reservoirs, *Cascades, Model studies, Rainfall, Controlled storage, Stochastic hydrology, Evaporation, Catchment areas, Overflow.

Through consideration of one or more conceptual reservoirs to model the time distribution of outflows from catchments fed by rainfall, the characteristics of random rainfall inputs (including evaporation and catchment abstractions) are modified and catchment outflows are obtained with moment characteristics that are functions of the parameters describing the nature of the conceptual reservoirs. The stochastic differential equation describes the storage balance in the conceptual reservoir. The Nash cascade is expanded into a stochastic reservoir cascade. The variations in no more than two parameters representing the nature of the conceptual reservoir are sufficient to describe catchment outflows with widely varying moment properties and correlation characteristics. (Murphy-IVI)
W84-03342

IDENTIFICATION AND PREDICTION OF NONLINEAR HYDROLOGIC SYSTEMS BY THE FILTER-SEPARATION AUTOREGRESSIVE (AR) METHOD: EXTENSION TO HOURLY HYDROLOGIC DATA,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
M. Hino, and M. Hasebe.
Journal of Hydrology, Vol. 68, p 181-210, 1984. 16 Fig, 5 Tab, 9 Ref.

Descriptors: *Hydrologic models, *Rainfall-runoff relationships, Groundwater runoff, Surface runoff, Groundwater flow, Estimating, Predicting, Rainfall.

A direct extension of an earlier proposed method for the daily runoff data analysis may not be applicable to the analysis of hourly hydrologic data. A few modifications are suggested. The cut-off frequency to separate the total runoff time series into component runoffs was determined by the slope of the semi-logarithmic plot of the recession curve. Coefficients of the autoregressive moving average model applied to each of the subsystems were determined by the least-squares criterion from the recession period data when rainfall stopped. Nonlinear hourly hydrologic systems appeared easily and precisely identified by this method. Each subsystem of the surface runoff, interflow and groundwater runoff is linear. The nonlinearity of the rainfall-runoff system is caused mainly by the nonlinearity of the separation of rainfall into component rainfalls. The nonlinear separation rule of rainfall into rainfall components is derived from inversely estimated rainfalls. Time series of hourly rainfalls can be inversely estimated from hourly runoff by this method and it compares well with the observed effective precipitation time series regardless of the size of watershed. (Baker-IVI)
W84-03343

IDENTIFICATION OF A VOLTERRA SERIES CONCEPTUAL MODEL BASED ON A CASCADE OF NONLINEAR RESERVOIRS,
Technion - Israel Inst. of Tech., Haifa.
M. H. Diskin, A. Boneh, and A. Golan.
Journal of Hydrology, Vol. 68, p 231-245, 1984. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Rainfall-runoff relationships, *Reservoirs, *Model studies, Volterra series model, Rainfall, Runoff, Surface runoff, Cache River.

The Volterra series model based on a cascade of nonlinear reservoirs was originally proposed for the description of flood routing in open channels. Its possible application for modeling the surface runoff system was examined. The model fulfills all the conditions specified for kernel functions of conservative systems, as well as additional conditions derived from observations of the nonlinearity observed in surface runoff systems. Other features include the compactness of the model, the linkage between the two kernel functions that form the model, and the physical basis of the equations that describe the kernel functions. For the Cache River data used, the optimal values of the parameters of a model based on a cascade of linear reservoirs can serve as a good starting point for the search for optimal parameters for the model based on a cascade of nonlinear reservoirs. The number of reservoirs in the cascade is restricted to be an integer, and the number is relatively small. The number is the same for both the linear and the nonlinear models. (Baker-IVI)
W84-03345

HOW TO USE A SINGLE-PARAMETER CONCEPTUAL MODEL IN HYDROLOGY (QUE PEUT-ON FAIRE EN HYDROLOGIE AVEC UN MODELE CONCEPTUEL A UN SEUL PARAMETRE),
C. Michel.
Houille Blanche, No. 1, p 39-44, 1983. 9 Fig, 7 Ref.

Descriptors: *Hydrologic models, *Mathematical models, Rural areas, Drainage basins, Rainfall, Evaporation, Model studies, France.

A single parameter conceptual model was developed for representing the daily flows of the typical Orgeval basin in an acceptable manner. The basin used in this study is a typical example of the small rural basins found in the north of France. In the model, there are two 'reservoirs': the superficial reservoir (S) receives a fraction of the rainfall and is subject to evaporation; the routage reservoir (R) receives the other fraction of the rainfall and it is from here that water drains. The model was first tested using a single parameter. When a second parameter was introduced, the results were found to be better during a period of filling, but not as good during a period of control. Better results were obtained when the model was modified so that there are five modules functioning in parallel, each representing 1/5 of the sloping basin. (Moore-IVI)
W84-03357

SEASONAL FLUCTUATIONS IN THE CARBON DIOXIDE PARTIAL PRESSURE IN A CAVE ATMOSPHERE,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
J. W. Troester, and W. B. White.
Water Resources Research, Vol. 20, No. 1, p 153-156, January 1984. 3 Fig, 21 Ref.

Descriptors: *Carbon dioxide, *Caves, *Seasonal variation, Tytoona Cave, Sinking Valley, Pennsylvania, Water flow, Partial pressures.

Many studies of the geochemistry of groundwater in carbonate terrains over the past decade have found it convenient and useful to characterize the water chemistry by a theoretical carbon-dioxide partial pressure. Carbon dioxide partial pressures were measured at 2 week intervals in a segment of a cave passage isolated by a water trap from mixing with outside air. The levels of CO2 fluctuated from 0.03 to 0.4 vol % being lowest in the winter and highest in the summer. The CO2 measured directly in the atmosphere and the CO2 partial pressure calculated from the pH and alkalinity of the underground stream have similar seasonal profiles. Evidence is strong that the CO2 concentration in both the conduit water and in the cave atmosphere is related to the growing season and to the type of soil and plant cover on the land surfce of the drainage basin nearby. (Baker-IVI)
W84-03422

MEIXNER FUNCTIONS FOR DERIVATION OF THE UNIT HYDROGRAPH,
Louisiana State Univ., Baton Rouge. Dept. of Civ Engineering.
V. P. Singh, and R. C. McCann.
Advances in Water Resources, Vol. 6, No. 3, 157-164, September, 1983. 14 Fig, 17 Ref.

Descriptors: *Rainfall-runoff relationships, *Ur hydrographs, Meixner functions, Watershed Rainfall, Runoff, Convolutions, Mathematic equations, Hydrographs, Linear programming.

The Meixner functions were used to relate t effective rainfall, the direct runoff and the ur hydrograph (UH) through linkage equations. Th linkage equations were then used to derive the U for given rainfall-runoff data on a small agricultu al watershed. The Z-transform was effectively er ployed to establish linkage equations relatin Meixner coefficients of the UH to those of th effective rainfall and the direct runoff. Meixn functions effectively derived the UH for the give watershed and synthesized the direct runoff hydr graph satisfactorily. Meixner functions produced UH which was not unduly sensitive to data erro These functions compare favorably with the lea squares and linear programming methods. (Bake IVI)
W84-03466

2B. Precipitation

SOME SPATIAL CHARACTERISTICS O DROUGHT DURATION IN THE UNITE STATES,
National Climatic Data Center, Asheville, NC.
T. R. Karl.
Journal of Climate and Applied Meteorology, V 22, No. 8, p 1356-1366, August, 1983. 9 Fig, 1 Ta 19 Ref.

Descriptors: *Drought, *Mathematical studie Statistical analysis, Correlation analysis, Palm Drought Severity Index, Precipitation.

The Palmer Drought Severity Index (PDSI), calculated from state averages of temperature an precipitation and from numerous single static analyses, demonstrates that droughts (as defined b the PDSI) persist longer in the interior of th United States than in areas farther east or we Contingency tables which use the PDSI as th predictor for the following one-month, six-mon and twelve-month precipitation anomalies (an also anomalies of precipitation minus potential ev potranspiration), are generally characterized b significantly greater skill in the interior portions the United States, confirming the notion that spe of abnormally dry or wet weather do have mo persistence in the Rocky Mountain and Hig Plains states than farther east or west. The for casts from the 'operational' PDSIs were not significant improvement from the precipitatio persistence forecasts. (Murphy-IVI)
W84-03043

RAINFALL ANALYSIS BY POWER TRAN FORMATION,
Mosul Univ. (Iraq). Dept. of Irrigation and Drai age.
H. Rasheed, A. S. Aldabagh, and M. V. Ramamoorthy.
Journal of Climate and Applied Meteorology, V 22, No. 8, p 1411-1415, August, 1983. 2 Fig, 5 Ta 10 Ref.

Descriptors: *Rainfall, *Measuring instrumen Mathematical studies, Power transformation, Pr cipitation, Rain gages.

Power transformation normalized the peak dai and peak monthly rainfall at various raingage st tions in Iraq. There were excellent correlatio between the coefficient of skewness (C sub s) and parameter for power transformation, coefficient kurtosis (C sub k) and the parameter for pow transformation, and between C sub s and C sub The relationship between C sub s and the param ter for power transformation will develop an es mation procedure for calculation of the transfo mation parameter. The method eliminates the u

of trial and error for estimating the parameter for power transformation. The annual series of monthly peak rainfall data shows that the log-Pearson Type III distribution offers estimates of rainfall similar to those of a power transformation. However, for data of less than 30 years period, a SMEMAX transformation gives estimates similar to those of a power transformation. A Gumbel distribution gives higher estimates. For daily peak rainfall data, log-Pearson Type III and Gumbel distributions give estimates close to those obtained by power transformation. SMEMAX transformation offers consistent lower estimates. (Murphy-IVI) 35
W84-03044

POTOMAC RIVER STREAMFLOW SINCE 1730 AS RECONSTRUCTED BY TREE RINGS,
Lamont-Doherty Geological Observatory, Palisades, NY.
For primary bibliographic entry see Field 2E.
W84-03145

PRECIPITATION OVER NORTHERN ITALY: A DESCRIPTION BY MEANS OF PRINCIPAL COMPONENT ANALYSIS,
SERMA, Milan (Italy).
F. Molteni, P. Bonelli, and P. Bacci.
Journal of Climate and Applied Meteorology, Vol. 22, No. 10, p 1738-1752, October, 1983. 10 Fig, 3 Tab, 35 Ref.

Descriptors: *Precipitation, *Italy, *Principal component analysis, Rainfall, Orographic precipitation.

The data sample used for the principal component analysis is formed by daily precipitation totals recorded at 35 rainfall stations during the periods October 1978-April 1979 and October 1979-April 1980. A spatial analysis is applied to the square roots of daily data and of their 3- and 5-day means, working on cross-product matrices obtained from both standardized and nonstandardized values. Four principal components (PCs) can be selected: the first is an index of the mean rainfall; the second represents the longitudinal differences; the third and fourth are representative of orographic anomalies. For daily data, these 4 PCs account for more than 80% of the total variance (since cross-product matrices are used in the analysis, the term variance must be interpreted as mean square value); this percentage is slightly higher working on nonstandardized values, but with standardized values the explained variance is distributed more uniformly among the 35 rainfall stations. Passing to 3- and 5-day means, the cumulative variance of the first 4 PCs increases; in particular, there is an increase for the first PC and a decrease for the others. These variations are compared with stability indices computed from the daily values of the PCs. The properties of high rainfall cases are well described by the PCs of 3-day values, whereas 5-day values are excessively smoothed. An orthogonal rotation, for which the criterion is based on physical considerations, is then applied to the first 4 PCs of nonstandardized daily values, the rotated patterns show a clear physical significance and can be related to different types of circulations in the lower troposphere over Europe. (Murphy-IVI)
W84-03146

THE UTILIZATION OF NIMBUS-7 SMMR MEASUREMENTS TO DELINEATE RAINFALL OVER LAND,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
E. Rodgers, and H. Siddalingaiah.
Journal of Climate and Applied Meteorology, Vol. 22, No. 10, p 1753-1763, October, 1983. 14 Fig, 10 Tab, 13 Ref.

Descriptors: *Nimbus-7, *Scanning multichannel microwave radiometer, *Rainfall, *Satellite technology, Remote sensing, Rainfall distribution, Rainfall intensity, Net rainfall, Meteorological data collection.

An empirical-statistical analysis using data from the Nimbus-7 scanning multichannel microwave radiometer (SMMR) detects rainfall areas over land. The addition of information from a lower frequency channel (18.0 or 10.7 GHz) improves the discrimination of rain from wet ground achieved by using a single frequency dual polarized (37 GHz) channel alone. Rain areas over land were determined from ground-based radar as were areas adjacent and upwind from rain areas. The probability for the mean vectors of any two populations being identical is less than 0.01 for classes sampled with surface thermodynamic temperatures > or = to 15 C, except for the rain over land and wet ground classes observed with the SMMR 37 GHz channel. None of the classes were signficiantly different for the classes with surface thermodynamic temperatures less than 15 C. For areas of large-scale heavy rainfall, a Fisher linear discriminant classifier determined the lower frequency SMMR channels were better able to delineate rain from wet ground than the 37 GHz channel. In areas of light rain and/or where the rain area did not fill the lower frequency instantaneous field of view the lower channels were not able to differentiate rain from wet ground. (Murphy-IVI)
W84-03147

SIMULATION OF A RAINFALL RECORD FOR THE SITE OF A NEW AGRICULTURAL DEVELOPMENT: AN EXAMPLE FROM NORTHERN SYRIA,
Reading Univ. (England). Dept. of Agricultural Botany.
M. D. Dennett, J. A. Rodgers, and J. D. H. Keatinge.
Agricultural Meteorology, Vol. 29, No. 4, p 237-258, 1983. 8 Fig, 4 Tab, 10 Ref.

Descriptors: *Rainfall, *Estimating, Syria, Model studies, Tel Hadya, Rainfall distribution, Precipitation.

A major concern among International Centre for Agricultural Research in the Dry Areas (ICARDA) scientists is the impact of weather, particularly rainfall, on crop productivity and, therefore it is important to know whether the experimental years to date were relatively wet or dry and how they fit into the long term expectations. Daily rainfall records for two sites in Nothern Syria are compared by fitting probability and frequency models to the observations. A model is interpolated for an experimental site at Tel Hadya, a site which is intermediate between the weather stations and for which long term measurements are not available. In dry years, at least, there may be some persistence of dryness over several months. Such long term effects are not included in the model, and thus it slightly overestimates rainfall amounts over long periods in dry years. It is possible to examine the rainfall patterns in recent years and place them in a long term context. (Baker-IVI)
W84-03211

SUPERCOOLED LIQUID WATER AND ICE CRYSTAL DISTRIBUTIONS WITHIN SIERRA NEVADA WINTER STORMS,
Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
M. F. Heggli, L. Vardiman, R. E. Stewart, and A. Huggins.
Journal of Climate and Applied Meteorology, Vol. 22, No. 11, p 1875-1886, November, 1983. 12 Fig, 2 Tab, 15 Ref.

Descriptors: *Climates, *Clouds, *Precipitation, Snow, Sierra Nevada Mountains, Storms, Measuring instruments, Meteorological data collections, Physical properties.

Cloud physics data measured by aircraft during two successive winter field seasons (1978-79 and 1979-80) operating over the Sierra Nevada Range have been examined to determine the distributions of supercooled liquid water and ice crystals. The data has provided a close look at the supercooled liquid water content and ice crystal concentration in winter storms. The cellular echo type clouds clearly exhibit the most desirable characteristics of significant liquid water and relatively little ice. The area-wide and banded echo type clouds provide fewer instances of significant supercooled water and have an abundance of ice crystals. Liquid water maxima were found near the freezing level irrespective of percipitation echo type. Convective clouds provided the greatest likelihood of significant supercooled water. The largest water contents were observed at the greatest temperatures, usually zero to minus five degrees C. Such climatological information suggests that a weather modification program should concentrate primarily on the convective clouds in order to enhance snowfall. (Baker-IVI)
W84-03303

DROUGHTS AND FAMINES IN INDIA - A HISTORICAL PERSPECTIVE,
Meteorological Office, New Delhi (India).
P. K. Das.
Mausam, Vol. 34, No. 2, p 123-130, April, 1983. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Drought, *Water shortage, India, Drought index, Water supply, Stochastic hydrology, Model studies.

Droughts and famines are associated with periods of decline in food production. But, it is by no means clear that a drought was always a precursor of famine, because the latter , a situation of distress, might have been caused by lack of communications and other economic factors. Historical records suggest that there were 14 famines between the 11th and 17th centuries and another 12 famines in the 90 year period from 1869 to 1958. A sharp increase was noted in number between 1860 and 1908. Famines did not always coincide with years of drought. Many famines appear to have been caused by a lack of adequate communication. Drought indices have been developed in recent years which have noted droughts in 1951, 1965-66, 1972, and 1974. A stochastic prediction technique is based on autoregression for monsoon rainfall. This is a variation of ARIMA, which has been used in econometrics but has an interesting application in Meteorology. (Baker-IVI)
W84-03304

A THEORETICAL STUDY REGARDING HETEROGENEITY OF RAINFALL OVER MADHYA MAHARASTRA,
Meteorological Office, Poona (India).
A. K. Mukherjee, and K. C. S. Ray.
Mausam, Vol. 34, No. 2, p 167-170, April, 1983. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Rainfall, *Seasonal variation, Madhya Maharashtra, Western Ghats, Rainfall distribution, Model studies, Orography, Geography, Forecasting, India.

A line of delineation running north-south across the districts of Madhya Maharashtra was suggested while studying the normal rainfall over these districts. This line roughly distinguishes the rainfall distribution in the talukas to the west and the talukas to the east during the months of July and August. This heterogeneity of rainfall on both sides of the line of delineation is explained. A two dimensional model for orographic rainfall was used. The line of delineation was shown to roughly coincide with the place where the rainfall due to orography becomes nearly zero in the east side of the Western Ghats. Forecasts for rainfall in these two sections during July and August should be made from different considerations. (Baker-IVI)
W84-03305

THE SUB-DIVISIONAL RAINFALL DISTRIBUTION ACROSS THE WESTERN GHATS DURING THE SOUTHWEST MONSOON SEASON,
Meteorological Office, Poona (India).
G. Ramachandran, and A. K. Banerjee.
Mausam, Vol. 34, No. 2, p 179-184, April, 1983. 3 Fig, 3 Tab, 2 Ref.

Descriptors: *Rainfall distribution, Western Ghats, Monsoons, Wind, Tamil Nadu, India, Karnataka, Madhya Maharashtra, Rainfall.

The behavior of rainfall across the entire length of the Western Ghats has been examined for the monsoon season from June to mid-September over a period of 7 years from 1970-1976. The weekly rainfall between a pair of sub-divisions across and adjoining the Western Ghats during the southwest monsoon season is not necessarily positively correlated along the entire length of the mountain barrier. The relationship varies from one region to another. In the nothern sector between the pair of sub-divisions Konkan and Madhya Maharashtra the correlation coefficient is +.67. Moving southwards in the central sector the correlation coefficient between the pair of sub-divisions, coastal Karnataka and Interior Karnataka, remains positive but decreases to +0.30. But moving still southwards, into the southern sector, the relationship reverses and a negative correation of -.25 is obtained betwen Kerala and Tamil Nadu. The correlation coefficients are all significant at the 1% level. The changes in the correlation coefficients may be due to the presence of a low-level trough in the westerlies across Tamil Nadu during weak monsoon epochs. The relationship in the weekly rainfall between the pairs of sub-divisions across the Western Ghats may serve as a useful tool to predict rainfall distribution across different regions of the Ghats both in weak and strong monsoon phases. (Baker-IVI)
W84-03306

INTERPOLATION OF SHORT DURATION RAINFALL FROM 24-HOUR RAINFALL IN LOWER GODAVARI BASIN,
Meteorological Office, New Delhi (India).
D. V. L. N. Rao, S. C. Goyal, and S. N. Kathuria.
Mausam, Vol. 34, No. 3, p 291-298, July, 1983. 1 Fig, 5 Tab, 4 Ref.

Descriptors: *Rainfall, *Flood control, Godavari Basin, India, Floods, Estimating, Mathematical equations.

The short duration rainfall estimates of less than 24 hrs are essential for the design of spillways, culverts, road and railways bridges over small and medium catchments. This is accomplished from ordinary non-recording raingauges estimates short duration extreme rainfall for given return periods. Using data of 14 randomly selected self recording raingauges (SRRGs) from an already existing network of 17 S.R. raingauges in lower Godavari basin, regression equations were filled between a short duration rainfall estimate and a 24 hour rainfall estimate for a given return period. The coefficients of regression curve were worked out by the least squares method with the basin as a unit. Using these constants and coefficients, estimates of short duration in a problem area were made. The short duration rainfall estimates for 12 and 50 year return periods were computed for three existing SRRG stations which were not used in the computation of regression coefficients and four ordinary raingauge stations in and around the sub-zone. The errors, on comparison are within reasonable limits. The technique presented in the paper can be employed to estimate short duration rainfall from daily rainfall records for any area. (Baker-IVI)
W84-03307

DROUGHT SPELLS OVER NORTH-CENTRAL INDIA DURING THE 1979 SOUTHWEST MONSOON,
Cochin Univ. (India). Dept. of Marine Sciences.
H. S. Ram Mohan, P. Vaisala, and B. V. Appa Rao.
Mausam, Vol. 34, No. 3, p 299-302, July, 1983. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Drought, India, Moisture deficiency, Vegetation, Jamshedpur, Seasonal variation, India, Monsoons, Wind.

Widespread drought spells were noted over north-central India during the 1979 summer monsoon. An attempt is made to study the impact of drought conditions on the short period water balances of representative stations in the region. Cumulative deviation techniques were used to delineate and categorize the intensity and duration of drought spells. Ecologically, a mild drought of prolonged duration was more detrimental to vegetation than an intense drought of short duration. During the study period, there were prolonged drought spells of large and severe categories which were capable of crippling the economy of the region due to their adverse impact on agricultural production. The water balance procedure can be used to effectively delineate periods and intensities of droughts from an ecoclimate point of view. It is suggested that these techniques are more rational in delineating areas and periods of drought and categorizing their severities. (Baker-IVI)
W84-03308

SEMI-QUANTITATIVE PRECIPITATION FORECASTS FOR GOMTI CATCHMENT BY SYNOPTIC ANALOGUE METHOD,
Meteorological Office, Lucknow (India).
J. Lal, J. S. Day, and K. K. Kapoor.
Mausam, Vol. 34, No. 3, p 309-312, July, 1983. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Precipitation, *Forecasting, India, Gomti Catchment, Catchment areas, Rainfall, Rainfall distribution, Uttar Pradesh, Rainstorms.

At present, reasonably accurate qualitative rainfall forecasts for areas of interest can be given 24 to 28 hrs in advance, though for hydrological forecasting, these do not serve the real purpose since quantitative precipitation forecasts are required for rainfall run-off relationships. A simple method was sought for the semiquantitative advance assessment of areal rainfall for the Gomti river catchment in Uttar Pradesh. Different types of synoptic situations are correlated with their resulting rainstorms over the catchment to prepare synoptic analogues for forecasting the range of areal rainfall. If the assessment of the synoptic situation can be made correctly with the available data at the time the forecast is issued and the direction of movement of the rainstorm producing weather systems can be predicted on the basis of all available meteorological information, then semi-quantitative precipitation forecasts can be made fairly accurately 24 hr in advance using the analogues for the Gomti catchment as given. Similar analogues can be determined in respect to other river catchments. (Baker-IVI)
W84-03309

BASIN PRECIPITATION ESTIMATES BY BETHLAHMY'S TWO-AXIS METHOD,
California State Univ., Northridge. Dept. of Geography.
A. Court, and M. T. Bare.
Journal of Hydrology, Vol. 68, p 149-158, 1984. 3 Fig, 3 Tab, 12 Ref.

Descriptors: *Precipitation, *Bethlahmy's two-axis method, Hydrology, Climatology, Mathematical studies, Thiessen polygons, Isohyets, Isohyet planimetry, Elevation, Numerical analysis, Raingages, Depth-area-duration analysis.

Annual precipitation during each of five years over each of eight U. S. river basins, 800-4200 sq km, was estimated by Bethlahmy's two-axis method, Thiessen polygons, Isohyet planimetry, elevation weighting and simple averages. Elevation weighting had the largest values, isohyetal computations the smallest. Straight averages were sometimes high, sometimes low. Estimates from Thiessen polygons and the two-axis method tended to be in the middle of the estimates more so for the two-axis method. When gages are numerous and rather evenly spaced throughout a basin, the direct average of their annual catches is an adequate estimate of yearly basin precipitation. Bethlamy's two-axis method agreed with the other methods, but were easier to compute than by Thiessen polygons. The two-axis method requires identification of the circumcircle diameter, construction of two perpendicular bisectors, and measurement of angles. (Murphy-IVI)
W84-03341

ANALYSIS AND MODELING OF PALMER'S DROUGHT INDEX SERIES,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
A. R. Rao, and G. Padmanabhan.
Journal of Hydrology, Vol. 68, p 211-219, 1984. 12 Fig, 7 Tab, 18 Ref.

Descriptors: *Drought, *Stochastic models, Model studies, Mathematical equations, Palmer's drought index, Kansas, Iowa, Forecasting, Rainfall.

The stochastic nature of yearly and monthly Palmer's drought index (PDI) series was investigated and characterized via valid stochastic models which may be used to forecast and simulate the PDI series. The monthly and annual PDI series for Iowa (1930-1962) and Kansas (1887-1962) are analyzed. The analysis of the PDI series indicates that long term oscillations and high persistence structure are important characteristics of drought indices and hence of droughts. The periodic behavior in drought index series is apparent in the conventional power spectra and also in the spectra computed by using high-resolution spectral methods. Rescaled range-lag characteristics also support these conclusions. Even so, the PDI series can be modeled by simple stochastic models which preserve the important statistical characteristics of the original data as demonstrated in this study. The simple models of PDI series developed can be used for generating synthetic PDI data and for forecasting PDI values which are used in agricultural planning and optimal operation of irrigation systems, respectively. (Baker-IVI)
W84-03344

A STOCHASTIC MODEL FOR A SMALL TIME-INTERVAL-INTERMITTENT HYDROLOGIC PROCESS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
C. D. Morris.
Journal of Hydrology, Vol. 68, p 247-272, 1984. 7 Fig, 8 Tab, 4 Ref.

Descriptors: *Stochastic models, *Precipitation, Rainfall, Model studies, Markovian precipitation distribution, Boneyard Creek, Morrow plots.

One of the major problems facing hydrologists is the lack of lang-term records of precipitation and streamflow. Simulation of hydrologic records by means of stochastic modeling is a commonly accepted statistical procedure to extend the record. A methodology is developed for the generation of intermittent small-time-interval (15 min) precipitation. The methodology consists of three components: a probabilistic wet-and-dry sequence component; a Markovian precipitation distribution component; and a regressive spatial-distribution component. The method is demonstrated by application to an actual precipitation network, the Boneyard Creek raingage network in Champaign-Urbana, Illinois. The trend in frequency of precipitation amounts from the 89 yr Morrow plots data are produced by the model using 13 yr of historical data. The model reproduces the mean and variance of storm precipitations, the storm lengths, the dry period lengths, the transition probability distributions of the precipitations and the autocorrelation structure of the network data. (Baker-IVI)
W84-03346

RECENT DEVELOPMENTS ON THE PROBABLE MAXIMUM PRECIPITATION (PMP) ESTIMATION IN CHINA,
East China Technical Univ. of Water Resources, Nanjing. Dept. of Hydrology.
Z. Daojiang, and Z. Jinshang.
Journal of Hydrology, Vol. 68, p 285-293, 1984. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Precipitation, *Estimating, China, Seasonal variation, Storms, Flood control, Probable maximum precipitation, Design criteria, Construction, Earth dams, Spillways, Reservoirs.

China is situated at the east of the Asian continent and in the subtropical and northern temperate zone of the Asian continental monsoon climate. Regional and seasonal characteristics of rain storms in China which introduce the most intensive rainfal

occurrences are examined. The techniques and practices involved in estimating the probable maximum precipitation from these storms is reviewed. Due to the lack of adequate streamflow data and abundance of heavy storms in China, it is very difficult and dubious to extrapolate a frequency curve to the long return periods required for a spillway of a major structure. In the design criterion of earth dams and/or rockfill dams (embankment) for reservoirs of major significance and also for important small dams the probable maximum precipitation and probable maximum flood should be used. Generalized charts of 24 hr point PMP have been developed. (Baker-IVI)
W84-03347

FOCUSING MECHANISMS IN THE TEXAS HILL COUNTRY FLASH FLOODS IN 1978,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
F. Caracena, and J. M. Fritsch.
Monthly Weather Review, Vol. 111, No. 12, p 2319-2332, December, 1983. 27 Fig, 19 Ref. USAF grant AFOSR-79-0125.

Descriptors: *Focusing mechanisms, *Texas, *Hill Country, *Flash floods, Air masses, Storms, Thunderstorms, Rainfall intensity, Runoff volume.

During the early morning of 2 August 1978, a stationary thunderstorm complex drenched the Balcones Escarpment of Texas and unleashed flash floods in the Hill Country which killed 27 people and produced extensive damage. After the storm, an unofficial 24 h total of at least 79 cm of rain was observed near the town of Bluff (about 90 km northwest of San Antonio). Five distinct mechanisms or meteorological features interacted to focus and anchor the storm complex. An east-west oriented mesohigh outflow boundary was situated just south of the storm area while a rapidly moving ribbon of extremely moist boundary-layer air flowed toward the storm area from the southeast. An elevated warm, dry layer of air extended over the area east of the Hill Country and capped the southeasterly low level inflow. A deep vertical motion field associated with a midtropospheric short-wave trough advanced toward the Hill Country from Mexico, and the diurnal heating cycle with its associated production of thermally forced convective clouds ended. The juxtaposition of the first four mechanisms over the storm area in combination with terrain lifting and the termination of convection initiated by boundary layer heating resulted in a forced, stationary storm complex that produced catastrophic flash floods in the Hill Country. (Murphy-IVI)
W84-03364

WATER POLLUTION ARISING FROM SOLID WASTE (COAL, FLY ASH, SLAG) DISPOSAL, AND MEASURES TO PREVENT WATER POLLUTION,
Electric Power Research Inst., Palo Alto, CA.
D. M. Golden.
Water Science and Technology, Vol. 15, No. 11, p 1-10, 1983. 10 Tab, 16 Ref.

Descriptors: *Water pollution prevention, *Waste disposal, Coal, Fly ash, Slag, Utilities, Environmental effects, Phytotoxicity, Groundwater pollution, Surface waters.

At the present, the annual world combustion of coal in electric power plants is about 2450 million metric tons coal eqv., resulting in the precipitation of 250-300 million tons of fly ash. Potential interactions of the environment with land-disposed utility wastes include: effects on local air quality, effects on soils and vegetation, phytotoxicity, groundwater effects, effects on surface waters, and disposal site washout. Both natural and engineered mitigating mechanisms are reviewed. These wastes are generally regulated as non-hazardous waste in the United States. Nevertheless, it is possible for non-hazardous waste to cause significant groundwater contamination. It is necessary for utility designers to consider the environmental risks and potential for liability when making engineering/cost evaluations of waste disposal options. (Baker-IVI)
W84-03372

THE METEOROLOGICAL OFFICE RAINFALL AND EVAPORATION CALCULATION SYSTEM - MORECS,
M. Field.
Agricultural Water Management, Vol. 6, No. 2/3, p 297-306, 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Rainfall, *Evaporation, Soil water, Permeability, Winds, Temperature, Vapor pressure, Soil moisture deficiency, Water loss.

MORECS is an operational system using a suite of computer programs which has as its output estimates of soil moisture deficit, evapotranspiration and hydrologically effective rainfall plus several meteorological elements in the form of averages over 40 x 40 km grid squares superimposed over Great Britain. The output is disseminated to a wide range of customers on the day that MORECS is run. The operational system is described in two stages: meteorological data collection/storage, and data manipulation. Meteorological elements used by MORECS include rainfall, sunshine, windspeed, temperature, and vapor pressure. (Baker-IVI)
W84-03442

INFRARED REMOTE SENSING FOR MONITORING RAINFALL,
EROS Data Center, Sioux Falls, SD.
D. G. Moore, J. C. Harlan, J. L. Heilman, D. O. Ohlen, and W. D. Rosenthal.
Agricultural Water Management, Vol. 7, No. 1-3, p 363-378, 1983. 7 Fig, 15 Ref. National Oceanic and Atmospheric Administration grant NA 80 AA-D-00032. Geological Survey contract 14-08-0001-20129.

Descriptors: *Monitoring, *Rainfall, *Remote sensing, Precipitation, Spatial distribution, Soil water, TIROS-N, Satellite technology, Weather satellites, Infrared imagery.

Evaluations of thermal infrared satellite data from TIROS-N and the Heat Capacity Mapping Mission showed that rainfall distribution patterns could be reliably detected on images acquired up to at least 3 days after the event. The temperature relationship decreased 8 days after the event when soil variations influenced the signal. A time-series analysis reduced thermal variability normally observed over diverse landscapes and increased the sensitivity of the procedures. The method of repetitive low-resolution thermal observations could be operationally employed over large geographic regions with currently available satellite systems. The results would augment the existing raingauge stations by increasing the spatial sensitivity and the reliability of detection and mapping individual rainfall events. (Baker-IVI)
W84-03455

DISTRIBUTION OF MEAN ANNUAL PRECIPITATION ACROSS SOME STEEPLAND REGIONS OF NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths, and M. J. McSaveney.
New Zealand Journal of Science, Vol. 26, No. 2, p 197-209, 1983. 7 Fig, 2 Tab, 13 Ref.

Descriptors: *Precipitation, *Annual distribution, New Zealand, Rainfall, Spatial distribution, Mountains, Mathematical models, Tararua Range, Kaweka Range, Mt. Egmont, Hunua Range, Waitakere Range, Model studies.

The spacial density of raingauges in lowland regions of New Zealand generally is adequate to define the position of isohyets on the 1:500 000 scale maps. But in steepland or highland areas, expecially those exceeding 1000 m in altitude, rainfall information is sparse, and position of isohyets unreliable. The position of maximum rainfall coincides approximately with the crest of the principal ridge. On both flanks of a range, rainfall distribution is a well-defined function of ground elevation and also of horizontal distance from ridge crest. Ranges are distinguished into two types according to whether the elevation of their principal ridge crest is less or greater than 1300 m. For the former type rainfall gradient with respect to elevation at ridge crest is a positive increasing function of crest altitude, and for the latter type a positive decreasing function. A quantitative non-linear model describing a single-valued relation between rainfall and elevation at ridge crests and calibrated by data from 6 New Zealand ranges has high precision and the status of a structural relation. An extension to the model defines a single-valued relationship between rainfall and elevation for a given transect but is multiple-valued otherwise. Repeated application of the model and its extension to a steepland region allows improved construction of rainfall isohyets. (Baker-IVI)
W84-03481

PHYSICALLY MEANINGFUL PARAMETERS THAT CHARACTERISE RAINFALL TOTALS AND RAINFALL EXTREMES,
Meteorological Service, Wellington (New Zealand).
K. J. A. Revfeim, and H. S. Hughes.
New Zealand Journal of Science, Vol. 26, No. 4, p 443-445, 1983. 2 Tab, 5 Ref.

Descriptors: *Rainfall distribution, Poisson ratio, Mathematical studies, Precipitation, Storms, Seasonal variation, Distribution, Rainfall intensity.

Seasonal patterns of total rainfall and extreme rainfall events can be described in terms of physically meaningful parameters. The physical parameterization of rainfall data will distinguish between regions having the same mean rainfall but where one region has few events of large average amounts and another region has significantly more events of smaller average amount. Characterization of rain by parameters of a Poisson process of event occurrence and of an independent distribution of event size provides a better basis for comparison between sites or regions than the empirical statistical characteristics commonly used. (Baker-IVI)
W84-03487

2C. Snow, Ice, and Frost

COMMENTS CONCERNING 'CONVECTION PATTERNS IN A POND',
Hawaii Univ., Honolulu. Dept. of Oceanography.
A. H. Woodcock, R. B. Lukas, and K. B. Katsaros.
Bulletin of the American Meteorological Society, Vol. 64, No, 3, p 274-279, March, 1983. 4 Fig, 11 Ref.

Descriptors: *Ice formation, *Albedo, *Snowmelt, *Temperature effects, *Convection, Ice, Ice water interfaces, Iced lakes, Ice cover, Snow cover, Ponds.

The article on 'Convection Patterns in a Pond' by K. B. Katsaros, Bulletin of the American Meteorological Society, Vol. 62, pp 1446-1453, 1981, stimulated the current authors to give further thought to their own and others' previous observations on this subject and specifically on direct and indirect convection effects. The weight of snowfall on ice-covered shallow ponds frequently causes upwelling of pond waters through leaks in the ice cover. The overall effect produced by dendritic melt centers surrounded by the patterned arrangement of altered albedo in the ice and snow on the pond suggests a pattern caused directly by differential melting of the ice and snow cellular convection from below. This pattern is also observed from plant stems projecting through the ice near shore, from openings along the shoreline, and from holes drilled in ice for experimental purposes. If the upwelling water temperature is too low for convection to occur in the water above the ice, then circular areas of melt and albedo changes might occur. The occasional regularity in the distribution of these patterns reveals the indirect role of convection cells in the water below the ice. (Geiger-FRC)
W84-02981

MICROCLIMATE AT ARCTIC TREE LINE 3. THE EFFECTS OF REGIONAL ADVECTION

ON THE SURFACE ENERGY BALANCE OF UPLAND TUNDRA,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
W. R. Rouse.
Water Resources Research, Vol. 20, No. 1, p 74-78, January, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Energy, *Advection, Heat flow, Tundra, Physical properties, Heat balance, Hudson Bay, Bays, Winds, Radiation, Climates, Frozen ground.

Energy balance components of net radiation, ground heat flux, and latent and sensible heat fluxes for upland tundra near the Hudson Bay coast at Churchill were measured continuously between April 25 and September 6, 1979. The measurements indicate a strong regional advective effect. In the postmelt period with cold onshore winds, which at Churchill blow from the north, sensible heating of the atmosphere was large, and heating of the ground was suppressed. For offshore winds from the south, ground heating was large and atmospheric heating suppressed. The net radiation and latent heat flux were little affected by wind direction. An atmosphere warming therefore should lead to a strongly increased ground warming by reducing the longevity of the Hudson Bay ice. It is also possible that the same advective factors that affect open tundra will also influence the forest at tree line, although at present no measurements of the atmospheric fluxes are available to support this thought. (Baker-IVI)
W84-03413

TRANSPORT OF WATER IN FROZEN SOIL. II. EFFECTS OF ICE ON THE TRANSPORT OF WATER UNDER ISOTHERMAL CONDITIONS,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 2G.
W84-03458

CLIMATIC EFFECTS ON THE RECESSION OF THE FRANZ JOSEF GLACIER,
Meteorological Service, Wellington (New Zealand).
J. W. D. Hessell.
New Zealand Journal of Science, Vol. 26, No. 2, p 315-320, 1983. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Glaciology, *Climatology, Glaciers, New Zealand, Recession, Snowfall, Rainfall, Temperature effects, Franz Josef Glacier, Meteorology.

Investigations of sequences of meteorological parameters observed over extensive periods on the West Coast of New Zealand have been compared with observations of the recession of the Franz Josef Glacier terminus. Independent investigations of the time series of precipitation, pressure gradient, and temperature have shown that prior to 1930, 3 years before the Glacier terminus commenced major recession, the 2 former parameters were significantly greater than in later years but that there has been no statistically significant increase in ambient temperature in the West Coast region. A depletion in the ice accumulation rate since 1930 has been the primary cause of the glacial recess there, and all glaciers with neves near the main divide, including those flowing eastward, have been affected. Temperature, precipitation, and other parameters such as radiation are not totally independent and during periods of near constant precipitation, short-period temperature anomalies may affect retreat rates of depleted glaciers. A significant advance of the Glacier could commence in 1983 or 1984 particularly in view of the heavy snowfalls in the springs of 1980, 81, and 82 and the wet, cold summer of 1982-83 on the West Coast. (Baker-IVI)
W84-03483

VARIATIONS OF THE STOCKING (TE WAE WAE) GLACIER, MOUNT COOK, AND CLIMATIC RELATIONSHIPS,
University of East Anglia, Norwich (England). Climatic Research Unit.
M. J. Salinger, M. J. Heine, and C. J. Burrows.
New Zealand Journal of Science, Vol. 26, No. 3, p 321-338, 1983. 15 Fig, 2 Tab, 26 Ref. DOE contract DE-ACO2-79EV10098.

Descriptors: *Glaciers, *Precipitation, *Temperature, *Stocking Glacier, *New Zealand, Climate, Principal component analysis, Multiple regression analysis.

A chronology of the fluctuating positions of the terminus of the Stocking Glacier, from 1869 to 1978 A.D., was derived from photographs. The changes in the glacier over the periods 1914-1974 and 1930-1974 are related with climatic variables by means of principal component regressions. The strongest associations of glacier variations for each of the periods examined are with smoothed monthly temperatures and precipitation data, with a lag of 2 and 5 years respectively. The similarity between each regression equations confirmed the stability of the method and identified temperature parameters as the more important factors correlated with glacier variations. Variation in Stocking Glacier terminus behavior accounted for by the 2 models is 83 and 71% respectively. (Author's abstract)
W84-03484

2D. Evaporation and Transpiration

DIRECT EVAPORATION FROM SOIL UNDER A ROW CROP CANOPY,
Agricultural Research Service, Akron, CO.
R. W. Shawcroft, and H. R. Gardner.
Agricultural Meteorology, Vol. 28, No. 3, p 229-238, 1983. 4 Fig, 15 Ref.

Descriptors: *Evaporation, *Soil moisture, *Canopy, Evapotranspiration, Mathematical equations, Lysimeters, Drainage, Flow, Surface water, Transpiration, Lysimeters.

Accurate measurements of soil evaporation under plant canopies are needed to refine the treatment of soil-surface wetness in irrigation-scheduling programs. Small lysimeters placed under a crop canopy to measure the soil evaporation component of evapotranspiration were constructed of rigid PVC pipe sections, 20.3 cm in diameter, and 20, 10, or 5 cm long. Water loss from the lysimeters was measured gravimetrically from composite 1-cm-increment cores sampled daily. The results reported are for two drying cycles of 16 and 13 days in July 1975 and 1976. In order for the lysimeters to behave as the surrounding soil, the water content of the lysimeters must be higher than the soil outside to compensate for changes under the natural conditions due to plant uptake, drainage and upward flow. Since the lysimeters depend on a set of compensating factors to directly measure E, estimates of E from them should be used with caution. A better use of the lysimeters would be to establish a relationship between lysimeter E and the surface soil water content and the use surface water content measurements to infer E. Several compensating errors must be involved in order for the lysimeters to simulate conditions of the actual soil surface. (Baker-IVI)
W84-03204

EVAPORATION FROM THE IRRIGATION WATER, FOLIAGE AND PANICLES OF PADDY RICE IN NORTH-EAST SRI LANKA,
Institute of Hydrology, Wallingford (England).
C. H. Batchelor, and J. Roberts.
Agricultural Meterology, Vol. 29, No. 1, p 11-26, 1983. 12 Fig, 21 Ref.

Descriptors: *Evaporation, *Canopy, *Vegetation effects, Plants, Evapotranspiration, Mathematical equations, Penman-Monteith equation, Rice, Transpiration, Panicles, Foliage, Irrigation water.

Fundamental to the design and operation of irrigation schemes is a knowledge of crop water use. The rate at which water is used by a particular crop is dependent on a number of factors which include age, variety, climate, soil-water availability, soil fertility, pests, diseases and cultivation, and irrigation practices. Combined measurements of leaf and panicle conductances with meteorological data in the Penman-Monteith equation were used to estimate transpiration from a paddy rice canopy. Evaporation from the panicles and the irrigation water accounted for a significant part of total evaporation from the paddy fields. The Penman-crop factor method of estimating paddy rice water used agreed well with the independent estimates of evapotranspiration here reported. After heading, the transpiration from the panicles accounted for 27% of the total transpiration of the canopy. The total evaporation for the 1981 cropping season from transplanting to harvest was 64 mm, of which 188, 395, and 63 mm were evaporated from the irrigation water, foliage and panicles, respectively. (Baker-IVI)
W84-03206

EVAPORATION FROM SCREENED CLASS A PANS IN A SEMI-ARID CLIMATE,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
T. A. Howell, C. J. Phene, D. W. Meek, and R. J. Miller.
Agricultural Meteorology, Vol. 29, No. 2, p 111-124, 1983. 9 Fig, 3 Tab, 15 Ref.

Descriptors: *Evaporation, *Screens, Semiarid lands, Water loss, Evapotranspiration, California, Climates.

Evaporation measurements from screened and standard Class A pans at two locations near Fresno, California were compared together and with potential evapotranspiration estimates, using two combination equations with climate data from the sites. The screen covering reduced the evaporation by 10% in a semi-arid environment. The evaporation reduction was largely attributed to differences in radiation interception by the screened pan. The evaporation from both type pans was highly correlated to potential evapotranspiration (ETO) estimates by the Penman and Van Bavel equations. Average annual pan coefficients for the open Class A pan were 0.81 and 0.91 for the screened Class A pan using the Penman equation calculations. Both pan coefficients were shown to exhibit a strong cyclical annual trend. When installed in standard grass weather station environments with adequate maintenance, evaporation pans can reliably estimate ETO, especially if the pan evaporation is averaged for time periods over 7 days. The screen covering served as a major obstacle to non-evaporative water losses from birds and animals commonly found at less protected sites, but the screen covering did not improve the correlations with potential evapotranspiration calculations. (Baker-IVI)
W84-03207

THE DIRECT EFFECT OF SHELTER ON EVAPORATION RATES: THEORY AND AN EXPERIMENTAL TEST,
Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
K. G. McNaughton.
Agricultural Meteorology, Vol. 29, No. 2, p 125-136, 1983. 2 Tab, 13 Ref.

Descriptors: *Evapotranspiration, *Windbreaks, Evaporation, Water loss, Shelterbelts, Advection.

Evaporation has been shown in previous work to be most strongly reduced during periods of strong sensible-heat advection. From theoretical considerations the use of an exchange flux as the measure of the effect of advection is proposed. The experiment of Miller is re-analyzed in terms of this exchange flux. In Miller's experiment evaporation rates from soybeans were measured directly using lysimeters, and secondary changes in plant growth and stomatal resistances were minimized. The exchange flux from Miller's lysimeter, located near the center of a semi-circular windbreak, was reduced to about half of its value in the open on most occasions. Thus the proposal that a windbreak can reduce the advective component of evaporation from a crop by reducing turbulent transport to the sheltered crop appears to be substantiated by theo-

retical and experimental evidence, if the advective component is identified as the exchange flux rather than the downward sensible heat flux. (Baker-IVI)
W84-03208

THEORETICAL AND MEASURED EVAPORATION RATES FROM AN EXPOSED PICHE ATMOGRAPH,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
K. T. Paw U, and M. Gueye.
Agricultural Meteorology, Vol. 30, No. 1, p 1-11, 1983. 2 Fig, 5 Tab, 22 Ref. NSF Atmospheric Sciences Section grant ATM-8021075.

Descriptors: *Evaporation, *Evaporimeters, *Measuring instruments, Energy budget, Temperature effects, Humidity, Wind speed, Radiation, Leaves, Water potential.

Evaporation and evapotranspiration influence the growth and even the survival of agronomic crops and livestock, forest species, and influence the water use strategies of human societies. A linearized energy budget for a leaf is used to predict the daily evaporation from a Piche atmograph. A one-to-one relationship was noted with observed evaporation, and accounted for 70-90% of the observed variance. Successful predictions were possible even when the meteorological data were taken at 12 hr intervals, although the most accurate predictions were based on data taken at 1 hr intervals. Sensitivity analysis predicts that Piche evaporation is strongly affected by air temperature, relative humidity, wind speed and long-wave radiation; albedo and short-wave radiation had lesser effects. The present study supports the idea that the Piche atmograph models the potential evapotranspiration of an individual leaf. The Piche evaporimeters and atmographs may be good analogs for potential leaf evapotranspiration because the equations used for modeling the Piche were originally developed for leaves. The definition used for potential leaf evapotranspiration is the evapotranspiration from a leaf when water is not limited, and when the physiological (mainly stomatal) resistance is effectively zero. (Baker-IVI)
W84-03213

SEASONAL ESTIMATES OF TRANSPIRATION FROM A MILLET CROP USING A POROMETER,
Nottingham Univ. (England). School of Agriculture.
S. N. Azam-Ali.
Agricultural Meteorology, Vol. 30, No. 1, p 13-24, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Transpiration, *Measuring instruments, *Crops, Millet, Porometer, Seasonal variations, Africa, Stomatal transpiration, Leaves, Water loss, Soil-water-plant relationships.

Water is one of the main constraints to agricultural production in many areas of the world since plant growth is closely related to transpiration. In west Africa, three populations of millet were grown to assess how growth was related to population and water supply. Stomatal resistance was measured with a porometer 3 times a day on 14 days. Boundary-layer resistance was estimated on the same days using blotting-paper replicas for the leaves, and wet- and dry-bulb thermocouples were used to determine concentration differences of water vapor. Changes in the mean rate of transpiration estimated from these quantities were strongly correlated with changes of green leaf area during the season. Seasonal changes of stomatal resistance were much less significant in determining the seasonal trend of transpiration rates. Estimates of water loss by transpiration agreed well with measurements of soil-water extraction obtained with a neutron moisture meter. This experiment suggests that the porometer is a useful alternative to the more established measurements of crop water use. Other useful information is obtained through the technique such as leaf temperature and vapor concentration differences between the leaf and the air. One major drawback is the time and labor spent in the field and on subsequent analysis of the data collected. A microprocessor incorporated in the porometer would allow semi-automatic calibration and enable direct calculation of transpiration per unit area of leaf, thus encouraging greater use of this technique. (Baker-IVI)
W84-03214

A DISCUSSION OF THE RELATIONSHIPS BETWEEN THE PRINCIPAL FORMS OF THE COMBINATION EQUATION FOR ESTIMATING CROP EVAPORATION,
Institute of Hydrology, Wallingford (England).
J. B. Stewart.
Agricultural Meteorology, Vol. 30, No. 2, p 111-127, 1983. 2 Tab, 26 Ref.

Descriptors: *Evaporation, *Vegetation, Forests, Canopy, Mathematical equations, Estimating.

To assist hydrologists and agronomists in estimating crop evaporation, the relationships between different forms of the combination equation are demonstrated by highlighting the assumptions used in their derivation and their data requirements. It is suggested that there is no formula which is superior in all situations. It is generally a compromise between data requirements and physical reality. By approaching the assumptions involved, an improved evaluation of the accuracy of the estimate of evaporation in each case can be made. Only the more complicated equation can give satisfactory estimates of the actual evaporation from all types of surfaces. For an area of low vegetation, which is rarely subject to significant soil moisture deficit, an estimate of the potential evaporation will provide a useful estimate of the actual evaporation. For areas of low vegetation and low rainfall, an estimate of the potential can still be used as an index and upper limit to the actual evaporation. For other vegetation types, and for forests in particular, the usefulness of an estimate of the potential evaporation is limited. If evaporation from a wet canopy is likely to be a sizeable component of the total evaporation, the potential evaporation may not even give a useful index of the actual evaporation. (Baker-IVI)
W84-03217

WATER BALANCE OF THREE IRRIGATED CROPS ON FINE-TEXTURED SOILS OF THE RIVERINE PLAIN,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
For primary bibliographic entry see Field 2I.
W84-03238

FIELD EVALUATION OF A WATER RELATIONS MODEL FOR SOYBEAN. I. VALIDITY OF SOME BASIS ASSUMPTIONS,
For primary bibliographic entry see Field 2I.
W84-03245

FIELD EVALUATION OF A WATER RELATIONS MODEL FOR SOYBEAN, II. DIURNAL FLUCTUATIONS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2I.
W84-03246

RESISTANCES TO EVAPOTRANSPIRATION FROM A ST. AUGUSTINEGRASS TURF CANOPY,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
D. Johns, J. B. Beard, and C. H. M. van Bavel.
Agronomy Journal, Vol. 75, No. 3, p 419-422, May-June, 1983. 3 Tab, 17 Ref.

Descriptors: *Evapotranspiration, *Turf grasses, Resistance networks, Stenotaphrum, Canopy, Stomatal transpiration, Water potentials, Water conservation, Air temperature, Dewpoint.

In St. Augustinegrass (Stenotaphrum secundatum) turf under adequately watered conditions, evapotranspiration was influenced to a greater extent by environmental factors which were external to the plants rather than by disposition of leaf stomata. Using an Ohm's law analogue to define a resistance network for the turfgrass canopy, magnitudes of resistances to water loss were measured and compared. Internal resistance was defined as aggregate diffusive resistance of the foliage and was determined from porometer measurements of diffusive resistance of leaves. External resistance was defined as the sum of aerodynamic resistance and resistance to air mass exchange within the canopy and was measured by three different methods. Internal resistance was only one-fourth to one-half the external resistance. Under wind speed conditions of 0.6 m/sec, actual evapotranspiration rates of St. Augustinegrass were only slightly lower than potential evapotranspiration rates. Chemical or genetic control of stomatal resistance would not result in appreciable savings of irrigation water. (Wheatley-IVI)
W84-03247

LEAF AND CANOPY TEMPERATURES OF PEARL MILLET GENOTYPES UNDER IRRIGATED AND NONIRRIGATED CONDITIONS,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 3F.
W84-03251

INFLUENCE OF WATER STRESS ON THE DIURNAL EXCHANGE OF MASS AND ENERGY BETWEEN THE ATMOSPHERE AND A SOYBEAN CANOPY,
National Oceanic and Atmospheric Administration, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab.
For primary bibliographic entry see Field 2I.
W84-03254

EFFECT OF FOLICOTE ANTITRANSPIRANT APPLICATION ON FIELD GRAIN YIELD OF MOISTURE-STRESSED CORN,
New Mexico State Univ., Las Cruces.
For primary bibliographic entry see Field 3F.
W84-03255

STRESS MEASUREMENT USING FOLIAGE TEMPERATURES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
G. K. Walker, and J. L. Hatfield.
Agronomy Journal, Vol. 47, p 623-629, July-August, 1983. 6 Fig, 2 Tab, 31 Ref. Univ. of California Agric. Exp. Stn. project 3462-H.

Descriptors: *Water stress, *Leaf temperatures, Stomata, Stomatal transpiration, Water deficit, Water vapor, Crop yield, Kidney beans, Moisture.

The total (stomatal and aerodynamic) conductance for water vapor of a crop (g sub v) reflects the rate of crop production. Determination of g should therefore be valuable in predicting crop yield. With an energy balance approach to crop stress assessment, foliage-air temperature differences (Tf - Ta) may provide a beans of determining g sub v. This study models the response of Tf - Ta to environmental parameters and conductances, and then, in a field experiment with kidney beans (Phaseolus vulgaris L.) grown under two radiation regimes, determines g sub v using measured Tf - Ta values, and relates this to crop yields. Kidney beans ('Red Kidney') were grown on deep Yolo clay loam (Typic Xerorthent) at Davis, Calif., under normal irradiance and with irradiance reduced by 50%. Different stress levels (different g sub v) were established by varying time and frequency of irrigation. Foliage temperatures (corrected for emissivity and sky radiation), net radiation and wet and dry bulb temperatures were recorded daily at 1/2 to 1 h after solar noon through most of the growing season. Seed yields were measured at the end of the season. In the energy balance model and field data Tf - Ta is sensitive to air saturation deficit (0.16C mb-1) and to net radiation (0.5C/100 W m-2). Relative yields estimated as g sub v/g(max)sub v, with g(max) sub v determined from well-watered plots, agreed well with relative seed yields (r = 0.75). Major Tf - Ta responses to saturation deficit and net radiation

showed that Tf based crop stress estimates will not relate well to crop production unless these environmental parameters are accounted for, or unless they vary little between times of measurement. By using the energy balance, Tf - Ta measurements can be related explicitly to g sub v and, thereby, to crop production. (Murphy-IVI)
W84-03257

EVAPOTRANSPIRATION AND YIELD ESTIMATION OF SPRING WHEAT FROM CANOPY TEMPERATURE,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
R. A. Diaz, A. D. Matthias, and R. J. Hanks.
Agronomy Journal, Vol. 75, p 805-810, September-October, 1983. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Evapotranspiration, *Wheat, *Crop yield, *Canopy, *Temperature, Water stress, Plant water potential, Water management.

Canopy temperature indices are related to evapotranspiration (ET) and grain yield (Y) for many crops at various locations. Irrigation-water management methods have recently been proposed which involve the use of remotely sensed crop canopy temperature to assess actual crop water needs on a real-time basis. this study evaluates three indices at a location different from where the indices were developed. The indices were the stress-degree-day (SDD), temperature-stress-day (TSD), and the crop-water-stress index (CWSI), and were tested at Logan, Utah on spring wheat (Triticum aestivum L. var. Fieldwin). Planting dates were 14. Apr., 28 Apr., and 19 May 1980. Canopy temperatures in differentially irrigated plots (36 X 3 m) were measured by infrared thermometry at midday from growth stages of heading to maturity. Net radiation, wind speed, humidity, and air temperature data were collected. Neutron meter measurements were used to calculate ET. Summations of SDD and summations of TSD and mean values of CWSI were calculated. Linear regression analysis for each planting showed large goodness of fit (r squared > or = to 0.93) for Et vs. summations of TSD, and for Et vs. summations of SDD (r squared > or = to 0.86). Large r squared values were obtained with Y vs. summations of TSD and Y vs. summations of SDD data. For the combined data from all plantings, r squared ranged from 0.90 for the ET vs. summations of SDD data to 0.21 for the Y vs. summations of TSD data. Slopes and intercepts of individual regression lines were significantly (alpha = 0.05) different. Goodness of fit of relative ET deficit with mean CWSI for the combined plantings was r squared = 0.86, and for relative Y decrease with mean CWSI, r squared = 0.78. Results indicate that SDD may be most suitable for wheat yield assessment and water management in northern Utah. (Murphy-IVI)
W84-03264

TURFGRASS EVAPOTRANSPIRATION. I. FACTORS INFLUENCING RATE IN URBAN ENVIRONMENTS,
Colorado State Univ., Fort Collins.
C. M. Feldhake, R. E. Danielson, and J. D. Butler.
Agronomy Journal, Vol. 75, p 824-830, September-October, 1983. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Turfgrass, *Evapotranspiration, *Evaporation rate, *Urban areas, Water management, Poa, Festuca, Cynodon, Buchloe, Lysimeter, Shade, Nitrogen, Water use, Moisture, Plant water potential.

Evapotranspiration (ET) by turfgrass in urban environment is site specific and can vary considerably from what would be predicted from regional climate. A large degree of heterogeniety exists in residential microclimate and lawn management practices. The relative importance of these factors needs evaluation to aid in planning for efficient use of municipal water, half of which is applied to lawns in some western areas. This study, using small lysimeters, evaluated the relative effects of mowing height, N fertility, shading, grass species, and soil composition on ET. Kentucky bluegrass (Poa pratensis L. var. 'Merion') mowed 5 cm used 15% more water than grass mowed at 2 cm. Thirteen percent more water was used when 4 kg/1000sq m of N was applied each month during spring and summer compared to only one application for the season, applied in the spring. Evapotranspiration by grass in 1979 was essentially the same whether growing on a clay soil or on a sand-peat mixture; however, a 6% decrease occurred for the soil system in 1980. Evapotranspiration increased linearly with solar radiation when an advective component of energy, accounting for 35% of ET, was subtracted from all solar treatments. Kentucky bluegrass and tall fescue (Festuca arundinacea Schreb. var. 'Rebel') which are cool-season grasses, used over 20% more water than bermudagrass. (Cynodon dactylon L. X Cynodon transvaalensis Davy var. 'Tifway') and buffalograss (Buchloe dactyloides Nutt) which are warm-season grasses. (Author's abstract)
W84-03266

RELATIONSHIPS BETWEEN LEAF WATER POTENTIAL, CANOPY TEMPERATURE, AND EVAPOTRANSPIRATION IN IRRIGATED AND NONIRRIGATED ALFALFA,
Minnesota Univ., St. Paul.
B. S. Sharratt, D. C. Reicosky, S. B. Idso, and D. G. Baker.
Agronomy Journal, Vol. 75, p 891-894, November-December, 1983. 4 Fig, 19 Ref.

Descriptors: *Leaves, *Canopy, *Temperature, *Evapotranspiration, *Irrigation effects, *Alfalfa, Water use, Plant water potential, Moisture deficiency, Moisture uptake.

A prerequisite to exploiting potential production of any crop is to accumulate a knowledge of plant responses, whether the response is to climate, fertilizer, or water. Evaluations during the daytime were on a Waukegan silt loam soil (fine-silty over sandy or sandy skeletal, mixed, mesic Typic Hapludolls) with stress differences between irrigated and nonirrigated alfalfa (Medicago sativa L.). Canopy temperature (CT), evapotranspiration (ET), and leaf water potential (psi l), served as indicators of stress and were measured using an infrared thermometer, portable chamber, and pressure chamber, respectively. Canopy temperature and ET did not differ appreciably between irrigated and nonirrigated alfalfa in early morning, but after 0900 h and throughout the afternoon nonirrigated alfalfa had a higher CT and lower ET. Leaf water potential of nonirrigated alfalfa was consistently lower during the day. The maximum difference in CT, ET, and psi l between irrigated and nonirrigated alfalfa occurred at 1500 h where they equalled 2 degrees C, 0.2 mm/h, and 0.7 MPa, respectively. These stress differences reflected the differences in the plant available water of 280 and 60 mm (corresponding to 117 and 25% of extractable water) in the 1.83-m soil profile of the irrigated and nonirrigated plots, respectively. Nonirrigated alfalfa psi l declined at a faster rate as the peak stress period (1500 h) was approached; however, after this period a faster rehydration was observed for this treatment, as indicated by the relationship between psi l and ET. Despite the faster rehydration of nonirrigated alfalfa, the degree of hysteresis was greater for this treatment than for irrigated alfalfa. The relationship between CT and ET indicated a larger rate of change in CT prior to the peak stress period for nonirrigated as compared to irrigated alfalfa. After this time and until 1700 h, CT remained constant as ET decreased, indicating a decreasing ratio between ET and net radiation and thus greater restrictions on water movement through the plant, a direct cause of the hysteresis observed. (Murphy-IVI)
W84-03270

ALFALFA RESPONSE TO SOIL WATER DEFICITS. II. PLANT WATER POTENTIAL, LEAF CONDUCTANCE, AND CANOPY TEMPERATURE RELATIONSHIPS,
Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics.
P. R. Carter, and C. C. Sheaffer.
Crop Science, Vol. 23, No. 4, p 676-680, July-August, 1983. 3 Fig, 2 Tab, 26 Ref. OWRT, USDI grant 14-34-0001-1236-B158 MINN.

Descriptors: *Alfalfa, *Soil moisture deficit, *Plant water potential, *Canopy, *Temperature, Evapotranspiration, Irrigation, Stomatal transpiration, Water stress.

Information is needed on the regulation of water vapor loss and on the plant water status of alfalfa (Medicago sativa L.) subjected to soil water deficits. Our objective was to characterize diurnal and seasonal plant water potential (psi p), leaf conductance (Gl), and canopy temperature (Tc) relationships for field-grown alfalfa. Measurements of psi p, Gl and Tc were made hourly from sunrise to sunset on 13 clear days from 10 July to 2 October on alfalfa subjected to a range of soil water levels during vegetative, bud, and bloom growth stages. Plant water potentials of well-watered plants were -0.1 to -0.4 MPa at sunrise and declined to -0.8 to -1.2 MPa at midday. With soil water depletions, psi p declined rapidly (0.08 to 0.4 MPa/day) and diurnal psi p cycling continued. Under severe plant water stress psi p were below -2.0 and -4.5 MPa at sunrise and midday, respectively. The Gl under high moisture conditions reached a peak of up to 0.033 m/s at midmorning and decreased gradually until sunset. At moderate plant water deficits, Gl was greatest during low transpirational demand periods (early morning and late afternoon) and depressed at midday. Under extreme plant water stress, Gl remained at low levels (0.001 to 0.003 m/s) the entire day. Stomatal closure at midday resulted in Tc up to 8.5 degrees C higher for water-stressed vs. well-watered alfalfa. Leaf conductance declined linearly with decreasing psi p until psi p reached -2.5 MPa. Below a psi p of -2.5 MPa, Gl stabilized at low levels. Regression coefficients (slopes) of the Gl vs. psi p (< -2.5 MPa) linear regression equations were greatest when daily maximum air temperature (MAT) was high and decreased as MAT declined. Under nonlimiting soil moisture conditions, Gl declined linearly Tc was reduced. Growth stage and daily pan evaporation did not influence the Gl - psi p relationship. (Author's abstract)
W84-03282

SIGNIFICANCE OF ACCELERATED LEAF SENESCENCE AT LOW WATER POTENTIALS FOR WATER LOSS AND GRAIN YIELD IN MAIZE,
Navarra Univ., Pamplona (Spain). Dept. Fisiologia Vegetal.
For primary bibliographic entry see Field 2I.
W84-03285

BIOMASS PRODUCTION IN WHEAT IN RELATION TO EVAPORATIVE DEMAND AND AMBIENT TEMPERATURE,
Indian Agricultural Research Inst., New Delhi. Div. of Agricultural Physics.
N. V. K. Chakravarty, and P. S. N. Sastry.
Mausam, Vol. 34, No. 3, p 323-326, July, 1983. 2 Tab, 7 Ref.

Descriptors: *Evaporation, *Irrigation, Wheat, Crop production, Biomass, Ambient temperature, India.

Biomass production in three varieties of wheat grown under irrigated field conditions was linearly related to cumulative evaporation and accumulated heat units above a certain threshold value. The intercepts for biomass production evaluated from the regression showed that about 35 days are needed for crop establishment for the linear relationship to be true between biomass and cumulative evaporation/accumulated heat, corresponding to 82 mm of evaporation and 497 degree days respectively. Biomass production estimates at different levels of cumulative evaporation and accumulated heat indicated the possibility of using the regressions for relative assessment of varietal response to prevailing atmospheric demand representing potential water requirements and the prevailing thermal regime which should prove useful as an additional tool in crop planning. (Baker-IVI)
W84-03310

A SENSITIVITY ANALYSIS OF A NUMERICAL MODEL FOR ESTIMATING EVAPOTRANSPIRATION,
SAR, Inc., Riverdale, MD.
P. J. Camillo, and R. J. Gurney.
Water Resources Research, Vol. 20, No. 1, p 105-112, January, 1984. 9 Fig, 2 Tab, 11 Ref, 1 Append.

Descriptors: *Evapotranspiration, *Mathematical models, *Evaporation, Weather, Energy, Simulation, Sensitivity analysis, Wheat, Soil water.

A simulation approach has been used to study the sensitivity of evaporation, estimated with an energy and moisture balance model, to the meteorological data used to drive the model. The numerical model solves the surface energy balance equation. Daily evaporation is calculated by integrating the instantaneous fluxes. A Monte Carlo method is used to apply random errors to the meteorological data, and constant biases are also applied. This was done for both bare and wheat fields. Previous sensitivity studies have used analytical methods, ignoring the interaction of the meteorological measurements, their biases, and the feedback mechanisms which couple the energy and moisture fluxes. The method described here removes these restrictions and does not require linearity and differentiability in the evaporation estimation technique. The numerical method was shown to produce results generally similar to those expected analytically for random errors under near-potential conditions. Measurement biases produced larger errors in evaporation than random errors. The method will be applicable for dry conditions, where an analytical approach is not feasible. (Author's abstract)
W84-03416

MEASUREMENT OF EVAPORATION BY A VAPOR BUDGET TECHNIQUE,
Clemson Univ., SC. Dept. of Civil Engineering.
B. L. Sill, J. E. Fowler, and W. R. Lagarenne, Jr.
Water Resources Research, Vol. 20, No. 1, p 147-152, January, 1984. 8 Fig, 8 Ref.

Descriptors: *Evaporation, *Vapor budget, *Lake evaporation, Water vapor, Wind, Fetch, Water budget.

A vapor budget method for measuring evaporation from lakes is described. The technique involves measuring the upwind and downwind horizontal water vapor flux in the atmosphere for air that passes over an exposed water body. The difference in the two fluxes is shown to be equal to the surface evaporation. Instrumentation used to measure the required vertical profiles of horizontal velocity and water vapor density is also described. The method is applied on a small pond (57 x 57 m) in southern California, and measurements are compared with hourly water budget values of evaporation. Despite the short fetch, which limits the thickness of the vapor layer, comparison of the vapor budget values and those obtained by the water budget method is favorable. Results from a limited number of measurements on a larger lake (with a 600-m fetch) are also presented. It is estimated that at the present state of development, the vapor budget method is accurate to approximately 20% for small- to medium-sized lakes. (Author's abstract)
W84-03421

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED GRAIN CORN IN CHINA,
California Univ., Los Angeles. Dept. of Geography.
W. H. Terjung, H.-Y. Ji, J. T. Hayes, P. A. O'Rourke, and P. E. Todhunter.
Agricultural Water Management, Vol. 6, No. 1, p 43-64, 1983. 14 Fig, 2 Tab, 15 Ref.

Descriptors: *Corn, *Water use, *Climate, *China, *Korea, *Evapotranspiration, Climate, Crop yield, Irrigation requirements, Model studies, Rainfall.

A basic parametric crop water use model (WATER) that employs climatic and environmental data to calculate temporal and spatial water consumption for a variety of major crops was applied specifically for grain corn to the region of China and Korea to investigate the evapotranspiration (ET) demand on grain corn and the associated irrigation water applications necessary for optimal crop production. A network of 241 stations provided the seasonal climatic input. The climatic input consisted of data averaged over approximately a 20 year period. Among the results, highest ET under full irrigation (first harvest) occurred in the northwestern inland sections of China, whereas least ET was found for the southeast. Under rainfed conditions, the relationship became nearly inverse. In order to achieve optimum crop yields, about 1000 mm of irrigation water was needed in the northwest, contrasted with none required in the south and east of China. A sensitivity analysis was applied to determine the degree of error introduced by faulty or uncertain environmental input data. (Author's abstract)
W84-03435

THE METEOROLOGICAL OFFICE RAINFALL AND EVAPORATION CALCULATION SYSTEM - MORECS,
For primary bibliographic entry see Field 2B.
W84-03442

A PRELIMINARY STUDY ON SCHEDULING IRRIGATION WITH CAN EVAPORIMETERS,
Andhra Pradesh Agricultural Univ., Hyderabad (India). Agricultural Research Inst.
M. Govind Reddy, Y. Yogeswara Rao, K. Subba Rao, and K. Ramaseshaiah.
Agricultural Water Management, Vol. 6, No. 4, p 403-407, 1983. 5 Tab, 3 Ref.

Descriptors: *Irrigation scheduling, *Evaporators, Irrigation efficiency, Wheat, Corn, Can evaporators, Hyerabad, India.

One of the most effective ways of increasing irrigation efficiency would be to provide farmers with a simple tool to schedule irrigation. Use of a class A pan by farmers is not practicable, but simpler evaporators, such as 'can' evaporators, may be useful. Field experiments were conducted in Hyerabad, India to study the relationship between a standard class A pan and a simple 'can' evaporator and to suggest irrigation scheduling for farmers using 'can' evaporators. The 'can' evaporators are made from one liter cans with a diameter of 10.5 cm, hung on posts. The bottom of the can was kept at a height of 30 cm above the crop level throughout the growing season. At the beginning of each irrigation, the water level in the can was brought to a reference point, 2.5 cm below the rim. Irrigation scheduling was carried out for wheat and maize grown in a semi-arid region, using cumulative pan evaporation (CPE). Scheduling of 60 mm depth of irrigation when CPE was 60 mm (IW/CPE = 1.00) was found to be optimum for wheat, while 60 mm depth of irrigation when CPE was 50 mm (IW/CPE = 1.20) was found to be optimum for maize. Cumulative evaporation from the cans (CCE), exposed above these crops, was recorded simultaneously. The ratios were higher over maize than over wheat. The CCE during the different stages of crop growth varied from 60.6 to 69.0 mm in wheat and from 51.5 to 94.0 mm in maize. The recommended depth of water in the can is obtained by multiplying the CPE with smoothed average CCE/CPE ratios. These depths may be marked inside the can for easy identification by the farmer. (Moore-IVI)
W84-03447

IRRIGATION IN THE GREAT PLAINS,
Kansas State Univ., Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W84-03452

ESTIMATION OF EVAPOTRANSPIRATION AT ONE TIME-OF-DAY USING REMOTELY SENSED SURFACE TEMPERATURES,
California Univ., Davis. Dept. of Land, Air and Water Resources.
J. L. Hatfield, A. Perrier, and R. D. Jackson.
Agricultural Water Management, Vol. 7, No. 1-3, p 341-350, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Evapotranspiration, *Remote sensing, *Surface temperature, Energy, Aerodynamic resistance, Net radiation, Air temperature, Wind.

The estimation of evapotranspiration on a regional scale may be possible using remotely sensed inputs to surface energy balance models. Energy balance considerations lead to a relation that includes net radiation, surface and air temperatures, and an aerodynamic resistance, as inputs. The resistance term was examined as to its behavior under both stable and unstable temperature conditions, several surface roughness conditions, and at various windspeeds. The model shows that the evapotranspiration is higher than net radiation when the surface is cooler than the air and lower when the surface is warmer than the air. The aerodynamic resistance changes due to surface-air temperature differences play a substantial role in determining evapotranspiration. To test the model, evapotranspiration was calculated using remotely sensed temperatures, with the remaining inputs conventionally assessed. The calculations were made for a one-time-of-day period near midday, as would be required for a remote sensing technique, and were compared to lysimetrically determined evapotranspiration. The measured data were obtained at several locations in the Western United States, and were for a variety of crops. The good agreement between calculated and measured values indicates that the goal of developing techniques that produce accurate evapotranspiration estimates over large areas is attainable. (Author's abstract)
W84-03453

ESTIMATION OF DAILY EVAPOTRANSPIRATION FROM ONE TIME-OF-DAY MEASUREMENTS,
R. D. Jackson, J. L. Hatfield, R. J. Reginato, S. B. Idso, and P. J. Pinter, Jr.
Agricultural Water Management, Vol. 7, No. 1-3, p 351-362, 1983. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Remote sensing, *Evapotranspiration, Surface temperature, Model studies, Satellite technology.

The estimation of evapotranspiration (ET) on a regional basis requires remote sensing inputs. When obtained from air or space platforms, remotely sensed measurements are usually made at periodic intervals, and are essentially instantaneous in nature. A problem, then, is the estimation of daily values of ET from one time of day measurements. A technique is presented that allows the calculation of the coefficient necessary to convert one time of day measurements to daily totals. Input requirements are latitude, day of year, and time of day. This coefficient was applied to measured one time of day ET values and the results were compared to lysimetrically determined daily totals obtained at five locations and for four crops. One time of day ET was also calculated using an ET model that requires remotely sensed surface temperatures. These values were converted to daily totals and compared with measured values. The results indicated that reliable estimates of daily total ET from one time of day measurements could be made for cloud free days. For cloudy days the results are less reliable, but they suggest that estimates may be improved by considering the amount and temporal distribution of cloud cover. (Author's abstract)
W84-03454

2E. Streamflow and Runoff

LOW FLOW SYNTHESIS BY COMPUTER; PART ONE,
Shawinigan Engineering Co. Ltd., Montreal (Quebec).
D. Duba, and J. R. G. Pitchen.
International Water Power and Dam Construction, Vol. 35, No. 10, p 52-54, October, 1983. 4 Fig.

Descriptors: *Streamflow, *Computers, *Model studies, *Low flow, Design criteria, Construction, Flow, Bolivia, Rivers.

A streamflow synthesis computer model was applied to check the reliability of extremely low flow values, which occurred within a sequence of monthly flows used for firm energy estimates for a Bolivian river basin. The Streamflow Synthesis and Reservoir Regulation (SSARR) model provided a useful tool for this purpose. It was used to determine whether, based on the recorded rainfall data, the model would synthesize low flows of the same order of magnitude as those recorded at Talula. In the coarse of the drainage basin model calibration, elements of runoff were determined by a trial and error method aimed at the best fit of two years of recorded flow data. Consequently it was possible to obtain runoff characteristics of the drainage basin which were previously not defined. The model contributed significantly to the understanding of the mechanism of runoff generation and of the interaction among the drainage basin hydrological characteristics. The validation run proved satisfactory and helped reassess the critically low flow estimates which had been received earlier. (Baker-IVI)
W84-02996

LOW FLOW SYNTHESIS BY COMPUTER; PART TWO,
D. Duba, and J. R. G. Pitchen.
International Water Power and Dam Construction, Vol. 35, No. 11, p 43-47, November, 1983. 12 Fig, 1 Tab, 2 Ref.

Descriptors: *Streamflow, *Computers, *Low flow, Model studies, Rainfall, Snowmelt, Hydrologic models, Bolivia, Icla Dam, Dams, Talula.

A model is described which can be used to synthesize stream flow data where the available information is sparse or non-existent. The model, SSARR, is a mathematical hydrologic model of a river basin system throughout which streamflow can be synthesized by evaluating snowmelt and rainfall. In the case cited, only the rainfall was applicable. Two of the three basic components of the model were used; a generalized drainage basin model for synthesizing runoff from rainfall, in which the total drainage basin is separated into relatively homogeneous hydrologic units for independent analysis before summing; and a river system model for routing streamflows from upstream to downstream points through channel storage. The predictive validity of the model proved satisfactory, and it contributed greatly to quantification of the runoff generation mechanism and interaction between drainage basin hydrologic characteristics. (Baker-IVI)
W84-02997

EFFECTS OF LATE-GROWING-SEASON INUNDATION ON TREE SPECIES IN THE CENTRAL PLAINS,
Kansas State Univ., Manhattan. Dept. of Forestry.
M. W. Melichar, W. A. Geyer, W. L. Loucks, and F. J. Deneke.
Journal of Soil and Water Conservation, Vol. 38, No. 2, p 104-106, March-April, 1983. 1 Fig, 8 Ref.

Descriptors: *Floods, *Water stress, *Trees, Central Plains, United States, Flood control, Cottonwood, Hackberry, Honeylocust, Mulberry, Black walnut, Reservoirs, Vegetation.

Recreational sites are associated with reservoirs developed for flood control and/or irrigation throughout the United States. Planners in charge of tree planting programs on floodplains should consider submersion tolerance of the trees. Sixteen species of trees that were completely or partially submerged following late summer flooding in central Kansas were observed. Generally, the species performed as reported in the literature. There were, however, some exceptions. Cottonwood, hackberry, honeylocust, and mulberry, which are normally regarded as tolerant species, had high death and/or stress rates, while black walnut, normally an intolerant species, had only 4% of the observed trees die following inundation. Complete inundation increased the number of dead and/or stressed trees compared with partial inundation. Tree damage was affected not only by the degree of flooding but also by the dormancy state of the trees at the time of inundation. Thus not only the flooding itself, but the season in which it occurred was a significant factor. Species that had hardened before the flood were not affected as dramatically as those species still growing actively. (Baker-IVI)
W84-03055

FIELD VERIFICATION OF RUNOFF CURVE NUMBERS FOR FALLOW ROTATIONS,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. M. Steichen.
Journal of Soil and Water Conservation, Vol. 38, No. 6, p 496-499, November/December, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Erosion control, Erosion, Model studies, Tillage, Farming, Agriculture, Conservation tillage, Soil conservation.

Conservation tillage practices leave most or all crop residue on the soil surface. This leaves the surface rough. This condition promotes infiltration and reduces runoff. When water infiltrates the soil, it is available for crop use or groundwater recharge. Runoff contributes to surface water supply but, if excessive, causes flooding. A portable rainfall simulator determines Soil Conservation Service runoff curve numbers for fallow rotations at two locations in western Kansas. Field studies supported the estimated curve numbers obtained by reducing published curve numbers up to 10% for residue cover. Runoff estimates from stubble-mulched areas in northwestern Kansas by reducing curve numbers for residue cover appear reasonable. Although there was some variation due to deep tillage or large cracks, they were relatively short-term conditions that no doubt would change with the next significant rain. Reducing the curve number can reduce significantly the water yield in a semiarid watershed. At Colby, a storm in excess of a 10 year event is needed to yield 12.7 millimeters (0.5 inches) of runoff. (Murphy-IVI)
W84-03070

MODEL OF MISSISSIPPI RIVER POOL: MASS TRANSPORT,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Civil and Environmental Engineering.
A. C. Demetracopoulos, and H. G. Stefan.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1006-1019, October, 1983. 13 Fig, 26 Ref.

Descriptors: *Computer models, *Mississippi River pool, *Mass transport, Hydrodynamics, Water quality, Dissolved solids, flow characteristics, Literature review.

A network of interconnected channels simulates the gravity and wind-driven flow in a river impoundment. A step-function specifies the forcing wind and a quasi-steady state simulation calculates the response for each timestep. A cells-in-series approach with appropriately sized subdivisions to account for dispersion simulates the transport of a conservative dissolved material through the system. The model is formulated and applied to Pool No. 2 of the Mississippi River, and compared with dye tracer data. A review of some field studies showing the importance of weather dependent processes in a shallow river impoundment is also presented. (Murphy-IVI)
W84-03084

THE INFLUENCE OF FLOW TURBULENCE ON FISH BEHAVIOR,
Akademiya Nauk SSSR, Moscow. Nauchnyi Sovet po Neorganischeskoi Khimii.
For primary bibliographic entry see Field 2H.
W84-03106

POTOMAC RIVER STREAMFLOW SINCE 1730 AS RECONSTRUCTED BY TREE RINGS,
Lamont-Doherty Geological Observatory, Palisades, NY.
E. R. Cook, and G. C. Jacoby.
Journal of Climate and Applied Meteorology, Vol. 22, No. 10, p 1659-1672, October, 1983. 9 Fig, 4 Tab, 37 Ref. NSF grants ATM81-08459 and ATM81-16184.

Descriptors: *Potomac River, *Stream flow, *Tree rings, Low flow, Climate data, Climatology, Stream discharge, Meteorological data collection, Drought, Point of Rocks, Maryland.

A 248-year reconstruction of the low-flow (July, August and September) period, of the Potomac River indicates that the prolonged drought of the 1960s may have been the most severe since 1730. There appear to have been several long periods of about 50 years in length when flow was generally above or below the long-term median flow. The period from 1900 through 1950, which comprises most of the measured flow period, was generally above median. Long-period climatic shifts can have important water resource implications. The Potomac River streamflow at Point of Rocks, Maryland was reconstructed by using tree-ring chronologies from sites in or near the river basin. Canonical regression analysis was used to reconstruct simultaneously July, August and September discharge after screening all the tree-ring predictors. Verification statistics and cross-spectral analysis indicate that the average reconstruction of these three months is most reliable for periods longer than about six years and shorter than about three years. Spectral analysis of the reconstruction indicates the presence of a 15.7-year periodicity that warrants verification through examination of meteorological data, as well as through additional streamflow reconstructions in the region. The reconstruction offers climatologists a greatly lengthened data base from which hypotheses can be formulated and inferences drawn about past behavior of the climate system. (Murphy-IVI)
W84-03145

RELATIONSHIP OF RUNOFF AND SOIL LOSS TO GROUND COVER OF NATIVE AND RECLAIMED GRAZING LAND,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
L. Hofmann, R. E. Ries, and J. E. Gilley.
Agronomy Journal, Vol. 75, p 559-602, July-August, 1983. 4 Tab, 16 Ref.

Descriptors: *Runoff, *Soil erosion, *Ground cover, *Grazing land, Model studies, Erosion, Infiltration, Land reclamation.

Vegetation cover is a dominant factor in controlling runoff and water erosion from agricultural land and an important criterion for determining adequate reclamation of strip-mined land. A simulated rainfall study conducted near Center, N.D. determines the relationship of ground cover factors to runoff and soil loss. The point frame technique was used to estimate vegetation cover as measured by either the first contact (first hit) of the sliding pins with live vegetation, litter, or bare soil and rock or by a similar contact of the sliding pins at the soil surface (surface hit). Artificial rainfall was applied at the rate of 46 mm/h to 4.0 X 22.1 m runoff plots located on 9 to 12% slopes within reclaimed and unmined pastures. Reclaimed treatments were ungrazed or grazed at light, moderate, or heavy intensity plus vegetation and litter removed by burning. Native ungrazed plots had greater live surface cover than ungrazed or lightly grazed reclaimed plots but similar soil loss, runoff, and soil loss/ runoff ratio (SL/RO). Best fit techniques revealed some cover factors linearly related to soil loss, runoff, and SL/RO; others logarithmically related. Live surface cover estimates were poorly related to runoff and soil loss. Adequacy of soil protection can be best estimated by percentage of bare soil. Runoff or soil loss estimates were similar whether total cover was estimated by surface hits or first hits; however, surface hits were easier to determine in tall vegetation under windy conditions. The point frame technique is satisfactory for estimating whether the cover is adequate to maintain soil stability on reclaimed land or

native range. Its use can be extended to estimate ground cover in other erosion studies. (Murphy-IVI)
W84-03256

ALLOCHTHONOUS DRIFT FROM BACKWATERS TO THE MAIN CHANNEL OF THE MISSISSIPPI RIVER,
Luther Coll., Decorah, IA. Dept. of Biology.
J. W. Eckblad, C. S. Volden, and L. S. Weilgart.
American Midland Naturalist, Vol. 111, No. 1, p 16-22, January, 1984. 1 Fig, 3 Tab, 17 Ref. NSF grant SPI-8026430, Upper Mississippi River Basin Commission contract 889-305.

Descriptors: *Rivers, *Benthic environment, *Backwaters, Mississippi River, Drift, Allochthonous drift, Ecosystem.

The backwater lakes typically occupy shallow floodplain basins with mean depths less than 1 m, have short mean flushing times, trap both sediments and nutrients carried by influent water, and have relatively high rates of biological productivity. Blooms of algae and extensive stands of aquatic macrophytes are common in these lentic habitats. A number of sources suggest the importance of these backwaters to the productivity of the large river ecosystem, but studies intended to systematically evaluate the magnitude of backwater inputs to the main channel have not been conducted. Drift in Pool 9 of the Upper Mississippi River was sampled using paried nets suspended at 0.6 m and 2.7 m depths. Diel periodicity in numbers, differences in depth distribution, and differences between sampling months were noted for the drift. Drift coming through large side channels, draining backwater habitats, had mean numbers 10 times larger than that in the main channel of the Mississippi River. This allochthonous drift was largely in transport at night and reflected the backwater area drained and, in part, the benthic communities of backwater lakes. The pulsed inputs of allochthonous drift have been largely ignored and may influence the main stem of a large river ecosystem. (Baker-IVI)
W84-03323

SPATIAL HETEROGENEITY AND MODELS OF SURFACE RUNOFF,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. C. Quimpo.
Journal of Hydrology, Vol. 68, p 19-28, 1984. 32 Ref.

Descriptors: *Spatial heterogeneity, *Model studies, *Surface runoff, Reviews, Watersheds, Mathematical studies, Mathematical analysis.

Spatial heterogeneity of the processes and parameters which determine surface runoff has given rise to different attempts to improve on the lumped system representation of the watershed. Techniques, ranging from the distributed formulation, component type lumped models and the use of partial source-area and geomorphological concepts are reviewed in order to identify possible areas of future inquiry. The methods tend to focus on different aspects of the problem as influenced by the resources available to the investigators in terms of data and computing capability and accuracy requirements as well as their analytical proclivity. The extensive documented evidence of spatial variability in most if not all of the parameters in the component models of the runoff process points to the requirement that a realistic model should allow for this heterogeneity. Constrained by the intractibility of a distributed model, it seems that a surrogate approach which tacitly allows for a distribution of parameters would be promising. The choice of an alternate mode must be tempered by the favorable likelihood of data availability to quantify the distribution. (Murphy-IVI)
W84-03334

THE KERNEL FUNCTION FOR WATERSHED RUNOFF MODELING,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
C. Shengjia.
Journal of Hydrology, Vol. 68, p 29-37, 1984. 3 Tab, 9 Ref.

Descriptors: *Kernel function, *Watersheds, *Runoff, *Model studies, Rainfall-runoff relationships, Mathematical models, Unit hydrographs, Flood discharge.

The relation of the damping effect and lag time is an important law for the kernel function of a watershed. The input steps, the process of flow contribution to a watershed, is the curve of the damping effect for the reservoir regressive flow. The damping effect may be represented in the form of a logarithmic exponent function. Both the storage coefficient and lag time possess the effect of damping. A quantitative formula of the nonlinear kernel function is not only simple but possesses general meaning for the analysis of the nonlinear kernel. An improved version of Ding's variable unit hydrograph formula is designed to differentiate between the concepts of the linear and nonlinear reservoir. No matter what the process of the flow contribution for nonlinear or linear is, all are effected by the damping and lag time. (Murphy-IVI)
W84-03335

URBAN DESIGN-STORM SENSITIVITY AND RELIABILITY,
Prickett (Thomas A.) and Associates, Urbana, IL.
For primary bibliographic entry see Field 4A.
W84-03336

MATHEMATICAL MODELLING FOR FORMATION AND PROPAGATION OF FLOODS IN A DATA-DEFICIENT BASIN,
Bihar Coll. of Engineering, Patna (India). Dept. of Civil Engineeering.
T. Prasad, and O. N. Wakhlu.
Journal of Hydrology, Vol. 68, p 311-329, 1984. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Flood control, *Model studies, Floods, River basins, Runoff, Nash model, Storms, Manning's roughness coefficient, Mathematical equations.

A continuing study on the application of some modern concepts and techniques in hydrologic analysis to practical problems of a river basin is reviewed. Limitations imposed by the type, length, frequency and reliability of data as well as by computational facilities available are reported. Two inter-related processes investigated are the formation of floods and propagation of a flood flow down a river channel. For the former, the concept of the instantaneous unit hydrograph representing the basin response in transforming rainfall to runoff and the analysis based on the Nash model are applied. For the latter, a modified Muskingum method is proposed. An expression for variation of Manning's roughness coefficient with stage and a mathematical formulation for river rating for all stages of flow including flood flows have been obtained and tested for their validity for a particular section of the Jhelum River. (Baker-IVI)
W84-03349

HYDRAULIC GEOMETRY OF FLOODPLAINS,
Illinois State Water Survey Div., Champaign.
N. G. Bhowmik.
Journal of Hydrology, Vol. 68, p 369-401, 1984. 15 Fig, 7 Tab, 20 Ref.

Descriptors: *Flood plains, *Hydrology, Geometry, River basins, Streamflow, Runoff, Drainage areas, Illinois.

The shape, the size, the extent, and the spread of present-day floodplains are the end-products of the dynamics of streams and river systems which have been working on the earth's crust from prehistoric times. The hydraulic geometry of floodplains for various river basins was investigated to determine the variability and similarity of the hydraulic geometry relationships for these river basins. Data for 9 river basins in Illinois and 4 river basins outside the state were analyzed. The Horton-Strahler stream-ordering system and the concept of hydraulic geometry, which are valid for streams in the humid areas of the United States are also applicable to the floodplains of the rivers. The floodplains are carved in a systematic manner and the development of the floodplains follows a systematic pattern. The floodplain hydraulic geometry parameters of width, depth and cross-sectional area are related to the stream order and they increase in the downstream direction. The other parameters, sinuosity, incision, 100-yr discharge and drainage area are also related to stream order and they increase in magnitude in the downstream direction. The magnitudes of each hydraulic or geometric parameter within each river basin and for each stream order have frequency distributions varying anywhere from skewed to the left, to symmetrical, to skewed to the right. The frequency distribution of the hydraulic parameters for the mountainous stream for each stream order is generally nonskewed. In Illinois, streams in the nonglaciated or infrequently glaciated areas are more sinuous than those in the glaciated areas. (Baker-IVI)
W84-03351

CRUE: A MODEL FOR CALCULATION THE PROBABILITY OF RIVER FLOODING (CRUE: UN MODELE D'ESTIMATION DES PROBABILITES DES DEBITS DE CRUE),
J. Miquel.
Houille Blanche, No. 2, p 95-103, 1983. 10 Fig, 11 Ref.

Descriptors: *Mathematical models, *Probabilistic process, *Flooding, Flood flow, Model studies, Computer models, Computers, Analog computers, Flow characteristics.

Many factors are involved with flooding probability models. Using descriptive information (meteorology, human influences, types of floods), flow characteristics and historic records it is possible to develop a functional and applicable model for calculating the probability of river flooding. The model can directly compute a series of observed flows (or depths) for large or small flood basins. The use of this model is facilitated by the availability of a computer program and a practical estimating guide. The control must be stationary and contain homogeneity. (Murphy-IVI)
W84-03359

AN ATTEMPT TO PRE-DETERMINE LOW WATER FLOWS IN STREAMS LOSING WATER IN CALCAREOUS REGIONS: EXAMPLE OF THE TILLE RIVER BETWEEN TIL-CHATEL AND SPOY (21) (ESSAI DE PREDETERMINATION DES DEBITS D'ETIAGE SUR LES COURS D'EAU PRESENTANT DES PERTES EN REGION CALCAIRE. L'EXEMPLE DE LA TILLE ENTRE TIL-CHATEL ET SPOY (21)),
Service Regional de l'Amenagement des Eaux de Bourgogne, Dijon (France).
M. Marion.
Houille Blanche, No. 2, p 119-126, 1983. 9 Fig, 5 Tab, 25 Ref.

Descriptors: *Prediction, *Low flow, *Streamflow, *Calcareous soils, *Tille River, Streamflow forecasting, Geomorphology, Karst, Karst hydrology, Mathematical studies, Graphical analysis.

While it is possible often to determine approximately the characteristic low level flows of a river at a hydrometric station, the transposition of these values to other points of the basin most often provides rough estimates, in particular because of the exchanges between the stream and sunken terrains. Transposition generally cannot be performed for water crossing karst sections by reason of the losses affecting the stream, which may cause it to dry up over very long periods. To solve this problem the flow is measured simultaneously at the hydrometric stations checking the flow at entry to the karst system, as well as at three points along the zone of losses. The threshold below which the flow entering the system is insufficient to prevent

the river from drying up, the characteristic flows at low water and the lengths of time the river remains dry for various return periods are defined for each site. (Murphy-IVI)
W84-03362

RUNOFF MODELS IN A SMALL URBAN WATERSHED: FIRST RESULTS OF AN EXPERIMENTAL STUDY (MODELE DE CRUE DANS UN PETIT BASSIN URBAIN: PREMIERS RESULTATS D'UNE RECHERCHE EXPERIMENTALE),
Universita di Reggio Calabria, Cosenza (Italy). Dipartimento di Difesa del Suolo.
F. Calomino, C. Colosimo, V. A. Copertino, and P. Veltri.
Houille Blanche, No. 2, p 131-140, 1983. 7 Fig, 4 Tab, 26 Ref.

Descriptors: *Runoff, *Watershed models, *Urban watersheds, Flood peak, Rainfall-runoff relationships, Runoff forecasting, Hydrographs, Literature review.

After a brief review of runoff models commonly proposed in the literature, some simple models are employed (Single linear reservoir model, Nash model, Kinematic model), in order to study the problems concerning peak flows in urban areas in Luzzi, Consenza, Italy. Different types of design rainfall are compared to determine the most effective method. A general indication on the application of these models and on the estimation of model parameters are inconclusive mainly because of insufficient data. (Murphy-IVI)
W84-03363

FOCUSING MECHANISMS IN THE TEXAS HILL COUNTRY FLASH FLOODS IN 1978,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W84-03364

DISAGGREGATION PROCEDURES FOR GENERATING SERIALLY CORRELATED FLOW VECTORS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, and R. M. Vogel.
Water Resources Research, Vol. 20, No. 1, p 47-56, January, 1984. 1 Fig, 40 Ref. 1 Append. NSF grant CME-8010889.

Descriptors: *Disaggregation, *Flow vectors, *Statistical models, Covariance, Computer models.

Disaggregation models provide a straightforward procedure for dividing annual or seasonal flows among subperiods and dividing aggregate flows among subbasins. The structure of disaggregation models places severe constraints on the feasible values of the lagged covariance of generated flow vectors. A new and simple class of disaggregation models is presented which employ disaggregation model structure but allow the models' innovations to be serially correlated. These models can reproduce: the covariance matrix of the disaggregated flows; their covariance with the upper level flows; and reasonable approximations to the lag one covariance of the disaggregated flow vectors given the constraints imposed by a disaggregation approach. Whlie the mathematical formulation of disaggregation models is independent of the dimension of Z sub t and X sub t, those values have a tremendous effect on the computer storage space and processing capacity necessary to use such models. To disaggregate simultaneous annual flows at 10 gages to monthly flows wold result in a matrix containing 1200 elements and a covariance matrix with 7260 distinct elements. One can reduce the size of an all at once disaggregation model if one chooses not to reproduce the observed sample covariance among every monthly flow observed at every site. More appealing from a modeling and computational point of view is to use a staged disaggregation procedure. The Mejia-Rousselle disaggregation model in general fails to reproduce the anticipated variances and covariances of the disaggregated flows because the model and its parameter estimators are not self-consistent. (Moore-IVI)
W84-03412

RIVER FLOW RECONSTRUCTIONS AND THEIR USE, PART 1,
University of East Anglia, Norwich (England). Climatic Research Unit.
P. D. Jones.
Water Services, Vol. 87, No. 1053, November, 1983. 10 Ref.

Descriptors: *River flow, *Model studies, River catchments, Catchment areas, River Thames, River flow reconstruction.

In order to demonstrate the accuracy of river flow reconstruction, the Central Water Planning Unit catchment model is fitted to the River Thames to Teddington over the period 1951-76. The estimated river flows for 1885-1976 are then compared with the measured river flows. While the exercise did not demonstrate conclusively that the model reproduces the characteristics of the last one hundred years flow on the River Thames, the results are in broad agreement. A discrepancy in the results for low flow of 9 months duration, and also for longer durations, is due to the use of a catchment with a high groundwater contribution to the flow. (Baker-IVI)
W84-03423

REGIONAL VARIABILITY OF SOIL CHARACTERISTICS FOR FLOOD AND LOW FLOW ESTIMATION,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
A. Gustard.
Agricultural Water Management, Vol. 6, No. 2/3, p 255-268, 1983. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Flood control, *River flow, Estimating, Soil properties, Europe, Rivers, Spatial distribution, England, Rainfall, Model studies, Drainage, Permeability, Slope.

The applied hydrologist is required to estimate extreme flood and low river flows for the design of flood control and water resource schemes. Many projects are located where river flow data are absent and indirect estimates of flow statistics must be made, either by using a rainfall-runoff model or by using empirical relationships between river flow statistics and the physical and climatic characteristics of catchment areas. The importance of the role of soil and geology in influencing the low flow behavior of rivers is illustrated by referring to the Low Flow Study of the United Kingdom of 1980. A current investigation of floods in European rivers is also examined which requires the development of a map displaying the spatial variability of the hydrological characteristics of the soils of Europe. On the regional, national and international scale it is difficult to use detailed observations of the physical characteristics of soils because of the problems of taking measurements at a large number of sites and over long periods of time. More immediate improvements in flood and low flow estimation will arise from an extension of soil surveying together with feedback at the catchment scale from an analysis of hydrological data. The wider use of field measurements of soil properties will improve physically based models of catchment behavior and estimates of soil moisture deficits from climate data, thus assisting in developing models appropriate for regional flood and low flow estimation. (Baker-IVI)
W84-03440

A NUMERICAL PROCEDURE FOR THREE-DIMENSIONAL TRANSIENT FREE SURFACE SEEPAGE,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
C. S. Desai, J. G. Lightner and S. Somasundaram.
Advances in Water Resources, Vol. 6, No. 3, p 175-181, September, 1983. 15 Fig, 1 Tab, 14 Ref.

Descriptors: *Surface flow, *Finite element method, Seepage, Surface runoff, Runoff, Dams.

Most of the numerical solutions studies based on techniques such as the finite difference, finite element and boundary integral methods have considered two-dimensional plane and axi-symmetric idealizations. Few studies, though, have considered three-dimensional analysis including confined, steady free surface and transient free surface flow. This three-dimensional analysis is based on a time-integration solution of the governing differential equations of flow. The procedure is applied for solution of transient free surface flow including verification with respect to test results from a lab model. It is capable of providing values of fluid heads, velocities and plots of equipotentials in structures such as dams, slopes and wells. (Baker-IVI)
W84-03467

HYDROLOGY OF A BASIN WITH EXTREME RAINFALLS- CROPP RIVER, NEW ZEALAND,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths, and M. J. McSaveney.
New Zealand Journal of Science, Vol. 26, No. 3, p 293-306, 1983. 7 Fig, 3 Tab, 37 Ref.

Descriptors: *Rainfall, *Hydrology, *River basins, Rivers, Runoff, Rainfall-runoff relationships, Cropp River, Alps, Mountains, Sedimentation, Floods, Vegetation, Precipitation, Rainfall intensity, Storms, Southern Alps, Erosion.

Cropp River, in the western Southern Alps, is a mountain torrent draining an area subject to frequent heavy rains. More than 100 storms occurred in 850 days of record. The rate of increase of rainfall depth with duration is independent of return period, and with respect to return period is independent of duration, for short return periods and comparatively short durations. Both rainfall isohyets and point rainfall intensities generally differ substantially from those predicted by national analyses of these parameters. Annual basin rainfalls could have been precisely predicted from annual mean water discharges. A high ratio of runoff to rainfall and a rapid runoff response to short-duration high-intensity rainfalls produce steep flood waves that rapidly translate down channel. More than half the runoff from storm rainfalls leaves the basin within an hour of rainfall ceasing. Specific annual suspended sediment yield could have been predicted approximately. Bedload is a small proportion of the total yield and it may move down channel in large floods as waves. The extreme precipitation is the dominating influence on the hydrological characteristics of upper Cropp basin and on the development of soils, vegetation, and geomorphology. (Baker-IVI)
W84-03482

2F. Groundwater

THERMAL IMPACT OF RESIDENTIAL GROUND-WATER HEAT PUMPS,
Missouri Univ.-Rolla. Dept. of Geological Engineering.
D. L. Warner, and U. Algan.
Ground Water, Vol. 22, No. 1, p 6-12, January-February, 1984. 8 Fig, 3 Tab, 7 Ref.

Descriptors: *Thermodynamics, *Groundwater, *Model Studies, *Groundwater potential, Simulation, Mathematical models, Hydrothermal studies, Thermal properties, Thermal pollution, Heated water, Heat transfer, Aquifers, Water reuse, Water cooling, Well water, Test wells, Pump wells, Heat pumps, Columbus, Ohio, Houston, Texas, Concord, New Hampshire.

Due to rising energy costs, ground-water heat pumps have come to be regarded as viable means of reducing space heating and air conditioning costs. A residential water-source heat pump is simply a device which exchanges heat between a source and a sink. A computer simulation quantifies the potential thermal impact of residential water source heat pump usage on groundwater aquifers. Weather data for nine locations throughout the country estimated the energy requirements for heating and air conditioning a typical resi-

dence. These energy requirements were translated into the volumetric water demands for a selected heat pump at each location. A representative model aquifer defined and characterized along with the heat pump water requirements and design (difference between inlet and outlet water temperature) identifies the important paramenters that contribute to heat transfer and models the movement of the thermal front resulting from injection of heat pump discharge water. The major factor that determines the heat pump thermal impact was the net amount of heat injected into, or removed from an aquifer. Other significant factors included well design, heat pump design, and physical properties of the aquifer such as thickness, porosity and dispersivity. In climates where winter heating demand is very nearly equal to summer cooling demands, the injection of heat pump discharge water did not cause any significant modification of the ambient model aquifer temperature. However, in hot or cold climates where air conditioning or heating demand dominates, measurable thermal changes occurred in the model aquifer. The maximum temperature change to be expected is fixed by the heat pump which is, at most, 20 degrees F for existing commercial heat pumps. The exception to this would be cases where interference between injection and production wells occurs, leading to recycling of water between them. There was good agreement between model-generated results and the data taken from an operating heat pump installation. (Murphy-IVI)
W84-03072

FLUORIDE IN THE GROUND WATER OF NORTHEASTERN OHIO,
Akron Univ., OH. Dept. of Geology.
R. G. Corbett, and B. M. Manner.
Ground Water, Vol. 22, No. 1, p 13-17, January-February, 1984. 5 Fig, 3 Tab, 18 Ref.

Descriptors: *Fluoride, *Groundwater, *Ohio, *Drinking water, Chemical analysis, Bedrock, Well water.

It is widely recognized that about 1 mg/l of fluoride is the optimum content of drinking water for proper dental health. Based upon the annual average of maximum daily air temperatures in the Akron area, the recommended control limits for fluoridation are 0.8 and 1.5 mg/l, with an optimum value of 1.1 mg/l. Fluoride contents range from <0.05 to 5.9 mg/l based upon 255 water samples collected from wells in nine counties of northeastern Ohio. Only 16 samples had fluoride contents exceeding 1 mg/l, and all are from the southern trio of counties. Furthermore, all samples high in fluoride are from wells close to or penetrating the contact between the Allegheny and Pottsville Formations. Data from a line of 34 wells for which logs were obtained indicate that high fluoride water occurs in either the lower part of the Allegheny Formation, or more probably, in the upper part of the Pottsville Formation. Ground waters high in fluoride are related to the bedrock geology. Fluoride data, particularly in the area of potentially high values, are important to health professionals in the prescription of fluoride supplements for children. Such prescriptions should be made only after the water has been tested. (Murphy-IVI)
W84-03073

THE INVESTIGATION OF AQUIFER PARAMETERS USING MULTIPLE PIEZOMETERS,
North West Water Authority, Warrington (England). Rivers Div.
S. Walthall, and J. A. Ingram.
Ground Water, Vol.22, No. 1, p 25-30, January-February, 1984. 6 Fig, 1 Tab, 6 Ref.

Descriptors: *Piezometers, *Aquifer characteristics, Geohydrology, Boreholes, Pumping tests, Groundwater storage, Geophysics, Confined aquifers, Aquifers.

The measurement of aquifer parameters including permeability, storage and piezometric head in an observation borehole is an important part of the assessment of the aquifer as a resource. In order to investigate the aquifer parameters of a fissured layered sandstone aquifer, it is necessary to construct and test an abstraction borehole using laboratory, double packer, geophysical and pumping test techniques. Good correlation was found between the techniques when the aquifer was represented by a fissured layered aquifer with low permeability bands separating layers of higher permeability. The use of multiple peizometers proved to be the only way of obtaining sensible results for field pumping tests and has given storage coefficients for both the confined and unconfined sections of the aquifer. (Murphy-IVI)
W84-03075

CONTAMINATION ANALYSIS - FLOW NETS AND THE MASS TRANSPORT EQUATION,
Florida Atlantic Univ., Boca Raton.
I. Watson.
Ground Water, Vol. 22, No. 1, p 31-37, January-February, 1984. 2 Fig, 1 Tab.

Descriptors: *Groundwater movement, *Flow pattern, *Path of pollutants, *Mass transport, Leachates, Groundwater hydrology, Permeability, Seepage, Groundwater pollution, Mathematical equations.

The introduction of newly-implemented regulations allows the hydrogeologist to participate in a more detailed way in the planning of waste disposal facilities. The level of hydrogeological input is a function of the nature and size of the project in question, since this, in turn, determines the budget available for investigation. A simple, analytical procedure for quantifying geohydrological data relating to waste site selection, groundwater contamination, and aquifer characteristics is presented. The analytical methodology outlined employs an extension of flow-net theory to determine seepage velocity and a derivation of the chemical mass transport equation to predict the attenuation of leachate constituents in the groundwater regime. The mathematical expressions derived take into account both transient and steady-state development of the plume, but are based on sufficient simplifying assumptions to facilitate convenient manipulation on a scientific calculator. The solutions obtained, although approximate, compare favorably with more costly computer-generated results. User application relates to the solution of first-order problems and in cases where a more sophisticated analysis is required, provides input for selecting the appropriate technique. (Wheatley-IVI)
W84-03076

REMOTE SENSING AND GEOPHYSICAL INVESTIGATIONS OF GLACIAL BURIED VALLEYS IN NORTHEASTERN KANSAS,
Kansas State Geological Survey, Lawrence.
J. E. Denne, H. L. Yarger, P. A. Macfarlane, R. W. Knapp, and M. A. Sophocleous.
Ground Water, Vol. 22, No. 1, p 56-65, January-February, 1984. 8 Fig, 17 Ref.

Descriptors: *Kansas, *Glacial aquifers, *Remote sensing, *Groundwater potential, Geophysics, Groundwater hydrology, Test wells, Seismic properties, Satellite technology.

Aquifers found in glacial buried valleys are a major source of good-quality ground water in northeastern Kansas. The extent and character of many of these deposits are not precisely known. Test drilling, Landsat imagery, shallow-earth temperature measurements, seismic refraction, surface electrical resistivity, and gravity data were used to evaluate two sites in Nemaha and Jefferson Counties. Tonal patterns on springtime Landsat imagery and winter/summer anomalies in shallow-earth temperatures were quick and inexpensive methods for locating some glacial buried aquifers and suggested areas for more intensive field studies. Reversed seismic refraction amd resistivity studies were generally reliable indicators of the presence or absence of glacial buried valleys, with most depth determinations being within 25% of test-drilling results. The effectiveness of expensive test-hole drilling was greatly increased by integrating remote sensing, shallow-earth temperature, seismic, and resistivity techniques in the two buried valley test areas. A gravity profile allowed precise definition of the extent of one of the channels after the other techniques had been used for general information. (Murphy-IVI)
W84-03079

DETERMINATION OF HORIZONTAL AQUIFER ANISOTROPY WITH THREE WELLS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
S. P. Neuman, G. R. Walter, H. W. Bentley, J. J. Ward, and D. D. Gonzaliz.
Ground Water, Vol. 22, No. 1, p 66-72, January-February, 1984. 5 Fig, 1 Tab, 8 Ref. 2 Append.

Descriptors: *Anisotropy, *Aquifer testing, *Pumping tests, Confined aquifers, Field tests.

Existing methods for the determination of horizontal aquifer anisotropy by means of pumping tests require a minimum of four wells, one for water withdrawal and three for drawdown observations. This paper shows how the same methods can be used to determine anisotropy with as few as three wells, if at least two of them can be pumped in sequence. A field example is included. A method of analyzing data from more wells than the above minimum, by least squares, is also described. (Author's abstract)
W84-03080

GEOHYDROLOGY AND HYDROCHEMISTRY OF THE DAKOTA AQUIFER, CENTRAL UNITED STATES,
Kansas State Geological Survey, Lawrence.
R. B. Leonard, D. C. Signor, D. G. Jorgensen, and J. O. Helgesen.
Water Resources Bulletin, Vol. 19, No. 6, p 903-911, December, 1983. 10 Fig, 28 Ref.

Descriptors: *Geohydrology, *Water chemistry, *Dakota aquifer, Aquifers, Dissolved solids, Groundwater recharge, High Plains, Brines.

The Dakota aquifer, composed of the Dakota Sandstone and stratigraphically equivalent sandstone units of Cretaceous age, is the upper-most regional aquifer underlying the extensively developed High Plains aquifer of the midwestern United States. The concentration of dissolved solids in ground water of the Dakota aquifer ranges from less than 500 milligrams/liter in calcium bicarbonate type water in the eastern outcrop area to more than 100,000 milligrams/liter in sodium chloride type oilfield brine in the Denver Basin to the west. Preliminary maps showing the distribution of dissolved solids confirm the complex nature of the Dakota aquifer as inferred from stratigraphic and hydraulic evidence. Extensive vertical leakage through confining layers, local recharge at the truncated eastern boundary, and a barrier to recharge along the western edge of the Denver Basin are consistent with the distribution of hydraulic head and dissolved solids. (Author's abstract).
W84-03394

KRIGED ESTIMATES OF TRANSMISSIVITY IN THE MESILLA BOLSON, NEW MEXICO,
Greenhorne and O'Mara, Inc., Denver, CO.
M. R. Palumbo, and R. Khaleel.
Water Resources Bulletin, Vol. 19, No. 6, p 929-936, December, 1983. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Kriging, *Transmissivity, *Mesilla Bolson, *New Mexico, Santa Fe Aquifer, Mathematical studies, Analysis of variance, Aquifer characteristics.

Kriging utilizes a statistically based procedure of spatial interpolation that incorporates the spatial correlation structure of the phenomenon, and provides an error estimate. Kriging was applied to a total of 141 transmissivity values in an attempt to quantify the transmissivity distribution of the Santa Fe aquifer in Mesilla Bolson, New Mexico. The analysis produced contour maps of estimated transmissivity values and associated estimation variances. Through variogram analysis and fitting of an exponential variogram to 141 natural log of transmissivity (lnT) values, the range was 3 miles,

the average variance 2.74 (theta sub lnT-1.65) with a mean of 8.65. Kriged estimates were generally lower compared to estimates based on available transmissivity maps. (Murphy-IVI)
W84-03397

A SIMPLE ANALYTICAL SOLUTION FOR THE BOUSSINESQ ONE-DIMENSIONAL GROUNDWATER FLOW EQUATION,
Thessaloniki Univ., Salonika (Greece). Lab. of Hydraulics and Hydraulic Works.
P. K. Tolikas, E. G. Sidiropoulos, and C. D. Tzimopoulos.
Water Resources Research, Vol. 20, No. 1, p 24-28, January, 1984. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Groundwater movement, *Mathematical equations, *Boussinesq equation, Differential equations, Piezometric head, Groundwater recharge.

Boussinesq's equation describing groundwater flow is a nonlinear parabolic partial differential equation. An approximate analytical method was developed for the solution of the nonlinear one-dimensional Boussinesq equation. Uniform initial conditions and a step function increase of piezometric head on the boundary are assumed. The analysis, based on integral relations, reduces the solution of the differntial equation to a simple system of nonlineart algebraic equations, which can be solved by hand. The analysis makes use of basic characteristics of the solution that are derived directly from the differential equation. The existence of an inflection point is established and the determination of its position clarifies the behavior of the solution. The technique can also be applied to one-dimensional nonlinear diffusion problems. The method cannot be applied to the problem of dewatering, due to the fact that an inflection point does not appear in the piezometric head profile and thus the basic qualitative and quantitative criteria exploited in the construction of the approximate solution are not applicable. For the problem of recharge of an aquifer from a stream, the method provides a very simple algebraic formula for the computation of stored volume and piezometric head profile. (Moore-IVI)
W84-03409

FINITE-ELEMENT METHODS BASED ON A TRANSPORT VELOCITY REPRESENTATION FOR GROUNDWATER MOTION,
Dienst Grondwaterverkenning TNO, Delft (Netherlands).
W. Zijl.
Water Resources Research, Vol. 20, No. 1, p 137-145, January, 1984. 6 Fig, 16 Ref.

Descriptors: *Groundwater movement, *Velocity, Solute transport, Advection, Computer models, Simulation, Mathematical models, Pollutants, Heat.

Since the primary transport mechanism of pollutants and heat in a subsurface flow system is advection, accurate determination of the velocity of the carrier fluid percolating through the porous medium is extremely important. Computer-based groundwater motion simulators conventionally use pressure as the primary variable, and after the pressure field is calculated, the velocity is determined by numerical differentiation. This paper presents an approach to a direct numerical solution of the transport velocity field. Evidence is provided to show that it is advantageous to base a finite-element-oriented simulator on a transport velocity representation (TVR) of Darcy's law. The computer code then requires less storage and fewer arithmetic operations than a pressure representation (PR) version of the same code, provided that the same accuracy for the transport velocity is required in both cases. (Author's abstract)
W84-03420

THE VARIABILITY OF RECHARGE OF THE ENGLISH CHALK AQUIFER,
S. R. Wellings, and J. D. Cooper.
Agricultural Water Management, Vol. 6, No. 2/3, p 243-253, 1983. 6 Fig, 9 Ref.

Descriptors: *Aquifers, *Recharge, England, Chalk aquifer, Groundwater recharge, Groundwater management, Groundwater pollution, Nitrates.

The Chalk aquifer is the major water supply aquifer in England. Arable farming is the predominant land use over most of the outcrop area and nitrate pollution associated with this is causing problems. The fissure system provides a potential fast route for pollutants to reach the water table. The hydrological behavior of the upper 3 m of the Chalk profiles appear to depend on two properties: the thickness of soil cover or the depth of disturbance of the Chalk, which controls the water storage characteristics at high matric potentials; and the saturated matric conductivity of the Chalk, which determines the frequency with which the fissure system becomes water-filled. (Baker-IVI)
W84-03439

SEEPAGE FROM LAKE BURULLUS INTO THE RECLAIMED MANSOUR AND ZAWIA POLDER AREA,
Euroconsult, Arnhem (Netherlands).
J. H. Boumans, and A. M. Mashali.
Agricultural Water Management, Vol. 7, p 411-424, 1983. 4 Fig, 5 Tab, 5 Ref.

Descriptors: *Groundwater movement, *Seepage, *Mansour, *Zawia, *Egypt, *Land reclamation, *Saline water, Lake Burullus, Polders, Drainage effects, Water table, Saline soils.

In 1960, a part of Lake Burullus, situated west of the north-central part of the Nile Delta, along the Mediterranean, was diked in, which created the Zawia and Mansour polder area of 27,300 ha. Reclamation was not fully successful, however, and the agricultural land is still highly saline. The groundwater tables are still too high and the drainage should be intensified and deepened. The thickness, nature and permeability of the clay cap overlying the extended sand and gravel aquifer are such that there is little risk that seepage will increase greatly after lowering the water-tables in the polder area. Piezometer studies indicated that seepage rates under the present conditions are very limited, which implies that an increase after improved drainage would remain very restricted. These findings were confirmed by calculations of the seepage flow for present and future conditions. The calculated seepage increase and the total future seepage inflow reaching the polder are minor and practically neglible compared with the available drainage capacity. Rates five to ten times higher than those calculated could easily be handeled by the existing drainage system. (Moore-IVI)
W84-03456

DELAYED YIELD. AN EXACT QUASI-THREE DIMENSIONAL MODEL FOR FREE-AQUIFERS,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Investigacion en Matematicas Aplicadas y en Sistemas.
I. Herrera, and B. Chen.
Advances in Water Research, Vol. 6, No. 1, p 54-58, March, 1983. 2 Fig, 17 Ref.

Descriptors: *Aquifers, *Model studies, Mathematical equations, Boulton's theory, Surface flow, Waves, Delayed yield, Leaky aquifers.

A quasi-three-dimensional model of free surface flows is developed for free aquifers and waves. The zero-order approximation of this model yields Boulton's theory of delayed yield, elucidating in this manner the nature of the latter theory. The study demonstrated the linearized theory of free-aquifers to be exactly equivalent to an integrodifferential equation in which the partial derivatives involved are taken in the horizontal directions only and time. When a cosine transform is used in the vertical direction a system of equations is obtained. If N terms are taken in the cosine representation an exact theory is obtained, except for the fact that the kernel w is approximated by the kernel w sub N. The zero-order approximation yields Boulton's delayed yield equation. The approximated kernel w sub N converges rapidly to the exact kernel w. This implies that if only one term is taken, a theory in which w has been replaced by w sub 1 is obtained, but it is otherwise exact. Such approximation seems to be quite adequate for most practical applications. (Baker-IVI)
W84-03460

OPTIMUM MANAGEMENT OF A REGIONAL CONFINED AQUIFER,
Thessaloniki Univ., Salonika (Greece).
D. Tolikas, P. Latinopoulos, P. Tolikas, and J. Ganoulis.
Advances in Water Resources, Vol. 6, No. 2, p 66-70, June, 1983. 8 Fig, 5 Ref.

Descriptors: *Confined aquifers, *Groundwater management, Management, Ptolemais, Greece, Mathematical models, Model studies, Optimization, Sensitivity analysis.

A management study was conducted for an aquifer-well system located in the industrial area of Ptolemais, Greece. An analytical solution for the steady state problem is obtained and parametric calibration of the mathematical model simulating the aquifer-well system follows. Calculated numerical results are compared with existing field data. An optimization model is introduced and the maximum possible discharge of the aquifer under continuously increasing pumping rates is calculated. A sensitivity analysis for the maximum discharge conditions follows and the basic assumptions of the mathematical model are checked. Furthermore an analytical relationship is obtained which describes qualitatively the development of the aquifer under pumping rate conditions. In general terms, due to the high value of the transmissivity as well as the limited hydraulic continuity with the neighboring aquifers the slopes of the hydraulic head are small, while a small increase of the pumping rate creates a considerable lowering of the hydraulic head. Therefore the maximum pumping rate from the aquifer is rather small and severe problems will appear in the near future in the industries of the region. (Baker-IVI)
W84-03461

ON THE APPLICATION OF THE BOUNDARY LAYER APPROXIMATION FOR THE SIMULATION OF DENSITY STRATIFIED FLOWS IN AQUIFERS,
Florida Univ., Gainesville. Dept. of Civil Engineering.
H. Rubin.
Advances in Water Resources, Vol. 6, No. 2, p 96-105, June, 1983. 5 Fig, 24 Ref.

Descriptors: *Density stratification, *Groundwater movement, *Boundary layers, *Simulation, Solute transport, Mathematical models, Computers.

Stratification of the density in groundwater flow stems from the contact between water which contains minerals in low concentration with water containing a high concentration of minerals. The flow in such a flow field should be simulated by solving simultaneously the equations of continuity, motion and solute transport, because solute concentration affects the dynamics of the flow. Such an approach is generally associated with complicated calculations and numerical schemes subject to problems of convergence and stability, as the basic equations are highly nonlinear. This study applies the phenomenological boundary layer approximation, and suggests a reference to three different zones in the flow field: (a) fresh water zone, (b) transition zone, and (c) mineralized water zone. In zones (a) and (c) it is assumed that the potential flow theory can be applied. In zone (b) the flow is nonpotential but the basic similarity conditions typical to boundary layers exist. The approach suggested in this study simplifies the mathematical models that should be used for the flow field simulation. This approach is especially attractive in cases where the Dupuit approxmation is applicable. In such cases very often analytical solutions can be obtained for unidirectional flows. In cases that are too complicated for representation by analytical solutions, the method can be used for the creation of simplified numerical schemes. Various

examples in this study demonstrate the application of the method for various field problems associated with steady state as well as unsteady state conditions. The simplicity of the method makes it useful for variety of problems. It can be used even by small institutions and small consulting firms, who have usually access to minicomputers and microprocessors. (Author's abstract)
W84-03463

THERMOHALINE CONVECTION IN FLOWING GROUNDWATER,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
H. Rubin, and C. Roth.
Advances in Water Resources, Vol. 6, p 146-156, September, 1983. 10 Fig, 6 Ref.

Descriptors: *Geothermal studies, *Groundwater movement, *Convection, *Salinity, Water temperature, Hydrodynamics, Dispersion, Aquifers, Hydraulic gradient.

Geothermal activity creates destabilizing temperature gradients which are significant in some aquifers. Usually, in such aquifers stabilizing salinity gradients also exist. The combination of temperature and salinity distribution in the aquifer may induce various types of hydrodynamic instabilities. The present article concerns the effect of anisotropic characteristics of the hydrodynamic dispersion on the growth of instabilities in the aquifer. Three different mechanisms may lead to instability of the flow field: (a) buoyancy forces may induce convection currents; if the difference between the convection velocity of salt, due to the hydraulic gradients, and that of heat is negligible, then this mechanism is generally most effective in planes parallel to the hydraulic velocity of the fluid (velocity due to the hydraulic gradient); (b) the difference between heat and salt effective diffusivities may lead to overstability; this mechanism is most effective in planes perpendicular to the hydraulic velocity; (c) the difference between the convection velocity of salt and that of heat may induce oscillations which are most effective in planes parallel to the hydraulic velocity. The growth of instabilities in an aquifer of unlimited length is different from their growth in an aquifer of limited length. In the latter thermohaline convection develops in planes perpendicular to the hydraulic velocity, whereas in the former it develops in planes forming an angle theta with the hydraulic gradient. The development of convection cells in the flow field is identified by numerical experiments. These experiments identify the convection cell length and the angle formed between the thermohaline convection plane and the hydraulic gradient. (Author's abstract)
W84-03465

CONVECTION IN AN AQUIFER ABOVE A LAYER OF HEATED IMPERMEABLE BEDROCK,
Auckland Univ. (New Zealand). Dept. of Theoretical and Applied Mechanics.
R. McKibbin.
New Zealand Journal of Science, Vol. 26, No. 1, p 49-64, 1983. 11 Fig, 2 Tab, 4 Ref.

Descriptors: *Geothermal studies, *Convection, *Geothermal aquifers, Heat flux, Boundary conditions, Bedrock, Temperature, Rayleigh number.

It has been proposed (Donaldson 1962 Journal of Geophysical Research 67:3449-3459) that a convective geothermal aquifer might overlie a layer of impermeable bedrock which conducts heat from the magmatic source below. Using perturbation analysis similar to that applied to general materially layered porous media by McKibbin & O'Sullivan (1980, 1981 Journal of Fluid Mechanics 96:375-393; 111:141-173), it is found that the presence of such a layer of bedrock markedly affects the convection patterns and heat flow compared with those which occur when the heat source is in direct contact with the convective system. Results show that the overall temperature difference between the heat source and the top surface required for instability is greater, while the heat flux is reduced for both impermeable and constant pressure upper boundary conditions. However the critical local (aquifer) Rayleigh number is decreased by the presence of the impermeable layer below. All effects are greater for the constant pressure top than for the impermeable top case. (Author's abstract)
W84-03480

2G. Water In Soils

WATER CONDITIONS IN CENTRAL CAUCASIAN SUBALPINE MEADOW,
Akademiya Nauk Gruzinskoi SSR, Tiflis. Inst. Botany.
C. Sh. Nakhutsrishvili, and Ch. Koerner.
Doklady Biological Sciences Vol. 267, No. 1-6, p 547-549, November-December, 1982. 3 Ref. Translated from Doklady Akademii Nauk SSSR, Vol. 267, No. 1, p 243-245, November, 1982.

Descriptors: *Meadows, *Water supply, Subalpine regions, Mountains, Central Caucasus Mountains, Soil water, Soil-water-plant relationships, Seasonal variations.

Studies were conducted in the region of Kazbegi to examine a Bromus variegatus-Agrostis planifolia-Trifolium ambiguum subalpine plant with special reference to water exhange of the soil, individual plants, and also the phytocenose as a whole. A high leaf water content, a negligible saturation deficit, and a high leaf water potential were noted throughout the growing season. In midsummer and during sunny weather and a 5-6 m/sec wind velocity, the transpiration of the studied plants was always higher in a pasture setting than in an ungrazed meadow setting. A tendency for a reduction in stomatal transpiration in the course of the day also was more strongly expressed in the hay meadow than in the pasture. The elevated water exchange in the pasture may be due to the lower diffusional and aerodynamic resistances of forb leaves and, also, the lower mean diffusional resistance of the phytocenose as a whole, conditioned by the sharp decline in grasses, which are predisposed to an elevated resistance. Grazing leads to a decline in the diversity of strategies in the phytocenose. (Baker-IVI)
W84-03025

QUANTITATIVE EXPRESSION OF SOIL-MOISTURE FUNCTION FOR REMOTE INDICATION,
Akademiya Nauk SSSR, Moscow. Nauchnyi Sovet po Neorganischeskoi Khimii.
B. V. Vinogradov.
Doklady Biological Sciences, Vol. 268, No. 1-6, p 16-18, January-February, 1983. 1 Fig, 4 Ref. Translated from Doklady Akademii Nauk SSR, Vol. 268, No. 4, p 1011-1013, February, 1983.

Descriptors: *Soil water, *Mathematical equations, *Remote sensing, Optical properties, Soil properties, Spectral intensity.

The quantitative expression of the relationship between remote optical characteristics and parameters of the natural environment is a major problem in the development of the fundamental bases of a space physical geography. Particularly difficult has been the mathematical description of the relationship between the coefficient of spectral intensity and soil moisture. Experimental investigations on loamy achromatic soils demonstrated the complex nonlinear characteristics of the relationship between the coefficient of spectral intensity (p) in the visible region of the spectrum and the moisture (w) of the 0-2 cm surface soil horizon. An equation is formulated which is the first to yield a quantitative expression of the p(w) function throughout the range of soil moisture and to reflect the phase composition of moisture in the soil. This permits broad extrapolation of remote soil-moisture indicators, minimization of preliminary sampling, and more rapid construction of p(w) calibration curves for changing natural and technical survey conditions. (Baker-IVI)
W84-03028

TRACING SUBSURFACE FLOW ON ROADCUTS ON STEEP, FORESTED SLOPES,
Intermountain Forest and Range Experiment Station, Ogden, UT.
W. F. Megahan, and J. L. Clayton.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1063-1067, November-December, 1983. 3 Fig, 2 Tab, 23 Ref.

Descriptors: *Storm seepage, *Permeability coefficient, *Roadcuts, Idaho, Sodium, Chlorides, Tracers, Saturated flow, Snowmelt, Macropores, Darcy flow.

In situ hydraulic conductivity was determined in a forested soil in the Idaho batholith by a tracer technique, and values were compared to hydraulic conductivity determined in the laboratory on cored samples. NaCl solutions were injected into piezometers placed in soil above a roadcut, and time for Na(+)or Cl(-) to appear in outlow at the roadcut during saturated subsurface flow generated from spring snowmelt was determined. Hydraulic conductivity values determined with the NaCl tracer averaged an order of magnitude greater than laboratory derived values. This is likely due to rapid flow in macropores formed from root channels or other biological activity that cannot be sampled by conventional coring and laboratory conductivity tests. Although the field tests indicated flow was clearly non homogeneous and anisotropic, an evaluation of the Reynold's number for the test conditions indicated Darcy flow was occurring. Sodium analysis provided a more distinct peak than Cl(-) when both concentrations were plotted vs. time. (Author's abstract)
W84-03177

A TRANSIENT METHOD FOR MEASURING SOIL WATER DIFFUSIVITY AND UNSATURATED HYDRAULIC CONDUCTIVITY,
Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
D. R. Scotter, and B. E. Clothier.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1068-1072, November/December, 1983. 8 Fig, 13 Ref.

Descriptors: *Permeability coefficient, *Soil water, *Diffusivity, Matric potential transient, Soil wetting, Sorption, Desorption, Outflow.

The method for measuring the unsaturated diffusivity of soil involves measurement of the matric potential transient at one end of a soil sample following a step change in the potential at the other end. Small potential steps can be used in contrast with the analogous outflow methods, because the difficult task of accurately measuring small flow rates is obviated. The analysis used to obtain the diffusivity from the potential data relies mainly on the delay in the transient and does not depend critically on its shape, thus avoiding the other major problem associated with outflow methods. With the use of the graphs provided, data analysis is simple. Measurement of the total outflow induced by each potential step allows the hydraulic conductivity to be calculated from the diffusivity. Except during primary wetting, the method provides hydraulic conductivity - water content data for repacked sand that showed no hysteresis and agreed with data obtained using a steady-state method. The anomalous behavior observed during primary wetting was perhaps due to entrapped air making the retentivity relationship time dependent. When applied to field cores obtained from both relatively permeable and impermeable soil horizons, the method gave consistent hydraulic conductivity data for sorption and desorption and for replicate cores. (Moore-IVI)
W84-03178

STATISTICAL AND STOCHASTIC ANALYSES OF HYDRAULIC CONDUCTIVITY AND PARTICLE-SIZE IN A FLUVIAL SAND,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
E. Byers, and D. B. Stephens.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1072-1081, November/December, 1983.

10 Fig, 6 Tab, 23 Ref. OWRT project B-073-NMEX.

Descriptors: *Permeability coefficient, *Particle size, *Fluvial sands, Statistical analysis, Stochastic process, Soil water, Socorro, New Mexico.

An untilled medium-grained fluvial sand near Socorro, New Mexico, was sampled in horizontal and vertical transects to study the statistical and stochastic properties of particle-size parameters and saturated hydraulic conductivity. Hydraulic conductivity is log-normally distributed, whereas the 10% finer, median, and geometric mean particle sizes are normally distributed. The strongest correlation between hydraulic conductivity and particle-size distribution parameters is that of the log of hydraulic conductivity with the 10% finer particle size. Stochastic analyses using the autocorrelation function and spectrum indicate that the log of hydraulic conductivity and particle size are characterized by dissimilar spatial correlation structures in the verticle directions. In general, particle size is more structured, regular, and predictable and shows a close similarity with the stratigraphy as observed in the field. On the other hand, hydraulic conductivity in the vertical direction may best be modeled as a simple random variable. Variogram and kriging analyses indicate that both hydraulic conductivity and particle size are relatively isotropic in the horizontal plane and that marked similarities in spatial structure exist in this plane. The spatial distribution of saturated hydraulic conductivity in the horizontal plane is estimated reasonably well using the empirical relationship between particle size and conductivity along with the kriged estimates of the 10% finer particle size. (Author's abstract)
W84-03179

EFFECT OF SOLUBLE SPECIES RELEASED FROM SOIL SOURCES ON THE COMPOSITION OF SOIL AND DRAINAGE SOLUTIONS,
Agricultural Research Organization, Bet-Dagan (Israel).
For primary bibliographic entry see Field 5B.
W84-03180

COLOR PATTERNS AND WATER TABLE LEVELS IN SOME INDIANA SOILS,
Purdue Univ., Lafayette, IN.
D. P. Franzmeier, J. E. Yahner, G. C. Steinhardt, and H. R. Sinclair, Jr.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1196-1202, November/December, 1983. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Water table, *Soil types, *Indiana, *Soil color, Soil properties, Seasonal variation, Soil horizons, Soil saturation.

Since many uses of soil depend greatly on its moisture status, it is important to be able to predict the seasonal moisture pattern from soil morphology. The relationship of color patterns in the soil profile to the duration of saturation at various depths was investigated in some soils that are extensive in Indiana. In soils of sandy, coarse loamy, fine loamy, fine silty, and fine particle-size families, some general relationship was observed between water table depths and soil color patterns. Horizons that have dominantly gray (chroma $<$ or $=$ 2) color in the matrix or argillans are saturated much of the year. Horizons that have gray mottles, but are dominantly brown, are saturated a few months of the year if they are above the dominantly gray horizons, or are saturated most of the time if these horizons are below the dominantly gray horizon. Horizons that have dominant chroma of three in the matrix, mottles, or argillans are often saturated. Those that have dominant chroma of five or six and have no mottles with chroma of three or less are seldom or never saturated. Soils with three-chroma matrix, mottles or argillans are much wetter than they had been thought to be. These generalizations apply to many soils, but there are exceptions. Some soil colors may be inherited from the parent material and do not reflect soil wetness. (Moore-IVI)
W84-03181

EFFECT OF SOIL TEXTURE ON CRITICAL BULK DENSITIES FOR ROOT GROWTH,
Agricultural Research Service, Temple, TX. Grassland, Soil and Water Research Lab.
C. A. Jones.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1208-1211, November/December, 1983. 6 Fig, 1 Tab, 12 Ref.

Descriptors: *Soil water, *Soil density, *Roots, Growth, Clay, Silt, Fragipans, Soil texture.

Published and unpublished data from 10 studies were analyzed to determine the effects of soil texture on critical bulk densities for rooting at near-optimum soil water contents. Highly significant negative relationships were found between percentage clay or silt + clay and the bulk density at which rooting was at a maximum or the bulk density at which rooting was 0.2 of that maximum. Similar relationships were also found between percentage clay or silt + clay and (i) the bulk densities of soil layers classified as fragipans and (ii) the maximum bulk densities at which 'many' roots are reported in U.S. Soil Conservation Service pedon descriptions. Thus, soil texture can be used to estimate bulk densities of fragipans and critical bulk densities at which root growth is severely affected at near-optimal soil water contents. (Author's abstract)
W84-03182

IRRIGATION DECISIONS SIMPLIFIED WITH ELECTRONICS AND SOIL WATER SENSORS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. W. Cary, and H. D. Fisher.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1219-1223, November/December, 1983. 6 Fig, 2 Tab, 5 Ref.

Descriptors: *Soil water, *Irrigation, *Wetting front, Drying rate, Water management, Microprocessors.

Two simple, inexpensive systems use electrical resistance measurements to provide useful, immediate information to assist decisions made on irrigation water application. In one system a microprocessor-based circuit coupled to a programmable calculator provides an on-site estimate of the time until the next irrigation will be required, based on field data and an operator-supplied parameter. The second system simply signals the arrival of the wetting front at any location in the soil by giving a visual indication, such as raising a mechanical flag. The microprocessor-based circuit measures and stores the resistance of four gypsum blocks once a day. The program in the portable calculator access this information and uses it to extrapolate the soil drying rate to predict the number of days until the next irrigation. By restricting the microprocessor circuit to data acquisition only and putting all number-handling routines into the calculator program, the cost and complexity of the microprocessor circuit is minimized, whereas maximizing the programming flexibility. This makes it feasible to install a number of these devices at different locations, all serviced by the same portable calculator. The water infiltration circuit intermittently scans eight sets of stainless steel electrodes to locate the soil wetting front during irrigation. When the resistance across the electrodes decreases, signaling the arrival of the front, the circuit trips a spring-loaded flag. This provides a visible sign that the wetting front has reached that point in the soil. The equipment worked well. When irrigation was required in six or fewer days, the microprocessor/calculator system made correct predictions 85% of the time. An example of how easily any irrigation scheduling method may be converted to the microprocessor/calculator system is presented. (Author's abstract)
W84-03183

AN EVALUATION OF THE SUCCESS OF MORECS, A METEOROLOGICAL MODEL, IN ESTIMATING SOIL MOISTURE DEFICITS,
Institute of Hydrology, Wallingford (England).
C. M. K. Gardner, and M. Field.
Agricultural Meteorology, Vol. 29, No. 4, p 269-284, 1983. 6 Fig, 5 Tab, 23 Ref.

Descriptors: *Soil moisture, *Estimating, MORECS, Rainfall, Evaporation, Evapotranspiration, Great Britain, Model studies, Water loss, Computers.

MORECS (Meteorological Office rainfall and evaporation calculation system) in its operational form uses daily meteorological data to produce weekly estimates of evapotranspiration, soil moisture deficit (SMD) and hydrologically effective rainfall for each square of a 40 x 40 km grid superimposed upon Great Britain. Grid square estimates of meteorological data are found using interpolation methods. A modified version of the Penman-Monteith equation is used to calculate evapotranspiration; a two-reservoir model is used to simulate the extraction of water in the SMD calculations. While the MORECS produces better SMD estimates for grass than earlier versions of the system, there is still a definite bias towards SMD overestimation in most years and underestimation in drought years. Better SMD estimations will arise only when good representative meteorological data is used. For the purpose of the hydrologist spatial detail is not normally needed and interest will be in the overall biases in MORECS SMD predictions explained here. However, for the agriculturalist who needs good SMD estimates for individual fields, errors of this type may be critical. (Baker-IVI)
W84-03212

SOIL WATER FLUX IN HUMID TROPICAL LATOSOLS UNDER COCONUT (COCOS NUCIFERA LINN.),
Center for Water Resources Development and Management, Calicut (India).
K. M. Varadan, and B. Raghunath.
Agricultural Meteorology, Vol. 30, No. 2, p 99-110, 1983. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Soil water, *Tropical regions, Coconuts, Humidity, Climates, Water supply, Kerala.

In the management of available water resources the necessity for estimation of seasonal variation in soil moisture storage will go a long way in proper planning for irrigation. For successful plant growth, the water supply should meet demand. The problem is that the evaporative demand of the atmosphere is continuous whereas the supply of water by natural precipitation is only occasional and irregular. Soil moisture storage depends on the soil water diffusivity, the cumulative infiltration and the distance that water penetrates the soil. Field observations were compared with those computed from meteorological variables. The field observations of soil moisture flux agree closely with computed values for wet periods of the year, while they differ significantly for dry periods. Modification was attempted for the climatic computation by taking into account a lower moisture depletion rate for the dry period. Soil moisture indices have been calculated for the study period as a basis for irrigation management. The observed soil moisture varies from 17.0 to 25.0 cm and 6.8 to 12.8 cm per 75 cm depth of soil profile for wet and dry periods, respectively. (Baker-IVI)
W84-03216

RELATIONSHIP OF IRRIGATION WATER SALINITY AND SOIL WATER SALINITY,
T. L. Prichard, J. L. Meyer, G. J. Hoffman, F. R. Kegel, and R. Roberts.
California Agriculture, Vol. 37, No. 7 and 8, July-August, 1983. 3 Fig.

Descriptors: *Soil water, *Salinity, Leaching, Irrigation water, Deltas, Conductivity, Water table, Irrigation effects.

Irrigation water quality has a dominant influence on soil salinity, but winter rainfall, soil properties, leaching practices, irrigation techniques, and the elevation and salt concentration of a water table can significantly affect the relationship. The relation between the electrical conductivity of the irrigation water and the average electrical conductivity of soil water in the root zone for a subirrigated portion of the experimental field is given.

Above average rainfall and maintaining the water table about 1 meter below the surface effectively leached the upper soil profile. Under present conditions of low salinity in the irrigation water and with normal winter rainfall, soil salinity is about 8 times greater than the salinity of the irrigation water. As the salinity of the irrigation water increases, however, the factor 8 becomes substantially smaller. (Baker-IVI)
W84-03221

WATER RETENTION EQUATIONS AND THEIR RELATIONSHIP TO SOIL ORGANIC MATTER AND PARTICLE SIZE DISTRIBUTION FOR DISTURBED SAMPLES,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
R. de Jong, C. A. Campbell, and W. Nicholaichuk.
Canadian Journal of Soil Science, Vol. 63, No. 2, p. 291-302, May, 1983. 4 Fig, 8 Tab, 20 Ref.

Descriptors: *Soil properties, *Organic matter, Water retention, Soil texture, Mathematical equations, Saskatchewan, Soil water.

Soil water retention curves are needed by many researchers in order to describe the availability of soil water to plants and to model the movement of water and salts in unsaturated soils. Functional relationships between soil water content and water suction were examined and related to textural and organic carbon content data. Soil water retention curves between 5 and 10,000 kPa were determined on disturbed samples of 18 soils representing various soil Great Groups in the Canadian prairies. The empirical two-straight-line model was the most suitable to relate soil water content to water suction. A very precise set of equations was developed for the samples chosen. Soil texture appeared to be the main soil property influencing the water retention curves of disturbed mineral soils. Organic matter increased the water content at which a break in the retention curve occurs, but had little effect on the rate of release of water or the soil suction at which the water became more difficultly desorbed. Water retention parameters calculated from particle size distribution and oganic carbon content data allow for general approximations of the relationship between soil water content and water suction. (Baker-IVI)
W84-03226

INTERMITTENT INFILTRATION AND EVAPORATION FROM SOIL COLUMNS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
M. A. Mustafa, R. De Jong, H. N. Hayhoe, and G. C. Topp.
Canadian Journal of Soil Science, Vol. 63, No. 2, p 303-314, May, 1983. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Soil water, *Infiltration, *Evaporation, Soil columns, Model studies, Richards' equation, Mathematical equations, Soil texture.

Large tracts of land in the arid and semi-arid regions of Sudan consist of salt-affected heavy clay montmorillonitic soils. Conventional reclamation procedures, including leaching and subsequent drainage, are not feasible because of the low hydraulic conductivity of these soils. Varying total amounts of water (160 and 320 mm) were infiltrated into 60-cm columns of air-dry saline sodic clay soil. The intervals between irrigation applications were varied from 5 to 20 days. The soil columns were subjected to a potential evaporation rate of 4.8 mm/day in a growth room. The cumulative evaporation followed a square root of time response, similar to that found by others for nonsaline soils of coarser texture. The percentage of water lost by evaporation was less for the high application rate treatments as compared to the low applicaton rate ones. Provided that more than 40 mm water were added, modelled estimates of evaporation were acceptable when predicted by the analytical solution of the Richards' equation. The versatile soil moisture budget model gave adequate predictions of evaporation and water content profiles, provided a field capacity measurement was taken. (Baker-IVI)
W84-03227

SOIL WATER DESORPTION CURVES ESTIMATED FROM LIMITED DATA,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
R. de Jong.
Canadian Journal of Soil Science, Vol. 63, No. 4, p 697-703, November, 1983. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Soil water, *Desorption, Estimating, Mathematical equations, Canada, Soil properties.

Measuring soil water desorption curves is time consuming, tedious and expensive. The soil water desorption curve, modeled as a power curve, can be approximated from a limited number of measured water contents at specific tensions. Applicability of the model was tested on 90 soils. By forcing the soil water desorption curve through different measured water contents at various tensions, and by modifying different parameters, both the shape and the position of the curve could be altered considerably. Measurements at the two extremes were the most important, if only two water contents were measured. The best results were obtained when the curve was fitted through three measured water contents, respectively, at saturation, at an intermediate (5.0-35.0 kPa) tension, and at a high tension (1500.0 kPa). (Baker-IVI)
W84-03229

PERENNIAL RYEGRASS GROWTH, WATER USE, AND SOIL AERATION STATUS UNDER SOIL COMPACTION,
Kansas State Univ., Manhattan. Dept. of Horticulture.
For primary bibliographic entry see Field 2I.
W84-03240

TILLAGE AND CULTURAL MANAGEMENT OF IRRIGATED POTATOES,
Iowa State Univ., Ames. Dept. of Agronomy.
D. R. Buxton, and J. C. Zalewski.
Agronomy Journal, Vol. 75, No. 2, p 219-225, March-April, 1983. 4 Fig, 5 Tab, 23 Ref.

Descriptors: *Tillage, *Cultural management, *Irrigation, *Potatoes, Soil compaction, Irrigation effects, Soil organic matter, Soil texture, Infiltration rate, Soil-water-plant relationships.

Many intensively row-cropped, irrigated soils are compacted and have slow water infiltration rates. Evaluating the relationship among soil compaction, water infiltration rates, and potato (Solanum tuberosum L.) yield and quality will help determine the influence of tillage and other practices on soil compaction, water infiltration rates, and potato response. Twenty-two commercial, irrigated potato fields were monitored and several tillage practices evaluated on soils from seven great groups. Soil compaction was evaluated by measuring penetrometer resistance. Although penetrometer resistance and water infiltration rates showed a large amount of variation in the 22 fields, they were not significantly correlated with each other. The correlation coefficient between penetrometer resistance 0.2 m below furrows and tuber yield was -0.38. Water infiltration rate was not associated with tuber yield nor quality. In the 18 fields with less than 600 g/kg sand, soil texture had little association with water infiltration rates, however, soil organic matter greater than 12 g/kg was positively associated with water infiltration rates. In the 22 fields, number of years between successive potato crops accounted for 33% of the variation in tuber yield with greatest yields when at least 4 years occurred between potato crops. In replicated tillage experiments, chiseling reduced penetrometer resistance to a deeper depth than moldboard plowing. Chiseling did not result in greater water infiltration rates, tuber yield, nor tuber quality than plowing. Chiseling and plowing in combination showed no advantage over either practice alone. Additionally, chiseling bed centers showed no yield advantage over an unchiseled check in fields that were previously plowed even though penetrometer resistance was reduced by chiseling. This study indicates that with proper irrigation management some deep tillage operations can be eliminated by many growers. (Murphy-IVI)
W84-03242

NUMERICAL ANALYSIS OF SOIL WATER MOVEMENT UNDER CONDITIONS OF RAPID INTERMITTENCY OF WATER APPLICATION,
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
M. Banerjee, and K. K. Watson.
Water Resources Research, Vol. 20, No. 1, p 119-125, January, 1984. 15 Fig, 6 Ref.

Descriptors: *Hysteresis, *Soil water, *Irrigation practices, Root zone, Wetting front, Sand, Permeability coefficient, Sprinkler irrigation, Infiltration, Timing.

When a sand material is subjected to a series of intermittent infiltration-redistribution cycles the hysteresis-affected material is limited to the surface horizons. Below this region, a zone of porous material exhibiting uniform water content and pressure head values develops. This zone is bounded at its lower end by the wet front and gradually lengthens as the cyclic wetting pattern continues. The development of the stable zone provides the basis for a simple in situ means of determining the hydraulic conductivity - water content relationship. The significance of the analysis in relation to sprinkler irrigation practice in regions of limited water supply is apparent. This is particularly the case where a fixed sprinkler system exists. If a control unit is introduced into the system, allowing the pulsed application of water, it is possible to control the rate of arrival of water to the root zone and generally balance this against the evapotranspiration demands of the system. Such a procedure would minimize drainage through the root zone to the lower soil horizons. (Moore-IVI)
W84-03418

EFFECT OF MIXED CATION SOLUTIONS ON HYDRAULIC SOIL PROPERTIES,
Haryana Agricultural Univ., Hissar (India). Dept. of Soils.
R. S. Siyag, R. Pal, S. R. Poonia, and T. C. Baruah.
Agricultural Water Management, Vol. 6, No. 1, p 15-25, 1983. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Permeability coefficient, *Soil water, *Diffusivity, Saturated flow, Unsaturated flow, Electrolytes, Sodium adsorption ratio, Clay loam, Sandy loam, Pore size.

Hydraulic conductivity (K) and soil water diffusivity (D) characterizing water flow under saturated and unsaturated conditions, respectively, were determined for a sandy loam and a clay loam soil, using water with different combinations of total electrolyte concentrations, C (i.e., 20, 40, 80, 125 and 250 meq/l) and sodium adsorption ratios (SAR). Both K and D increased with C and decrease with SAR. In low sodium adsorption ratio ranges (i.e., up to 20) the requirement of electrolyte concentration to maintain relative hydraulic conductivity = 0.5 was relatively more for sandy loam than for clay loam soil. However, the trend for electrolyte concentration requirements for the two soils was reversed at high sodium adsorption ratios (i.e. > 20). A spline function was used to draw the best fitting line through the data points of horizontal adsorption experiments. The reduction in K of these soils in relation to SAR is attributed to swelling, dispersion and migration of clay particles which result in the reorientation of soil particles and consequently affect the pore size distribution. Both swelling and movement of clay particles cause blocking of water conducting pores and hence a decrease in K. (Moore-IVI)
W84-03432

FUNCTIONING OF MOLE DRAINS IN CLAY SOIL,
Agricultural Research Council, Wantage (England). Letcombe Lab.
M. J. Goss, G. L. Harris, and K. R. Howse.
Agricultural Water Management, Vol. 6, No. 1, p 27-30, 1984. 1 Fig, 6 Ref.

Descriptors: *Subsoil drains, *Water table fluctuations, Drainage, Rainstorms, Clays, Soil properties,

Fissures, Mole drains, Water management, Model studies.

Observations of water-table fluctuation and drainflow are reported from a field experiment on a heavy clay soil with replicated 'mole-drained' and undrained plots. During a particular rainfall event the deep drains were the principal collectors yielding 86% of drainage water on the drained plots. Interflow was the most important collector for the undrained plots yielding 76% of drainage water. A direct comparison was made of the flow from the mole drains with the flow from the topsoil without interaction. The depth to the water table below the soil surface was least at the same time for both treatments and more than 1 hr later than the peak flow from the drains or collectors. The time of peak drainflow was the same on the drained and undrained plots, suggesting that flow into the drains was largely influenced by movement in the topsoil. The principal route of water from the soil surface to the mole drains was not uniformly through the subsoil, but rather via large fissures linking the topsoil with the mole channel. In the drained plots the water-table fluctuated within the subsoil which had only a small volume of drainable pores at each depth. Thus removal by the closely spaced mole drains of only a small volume of water caused a large fall in the water table. In contrast in the undrained plots the water flowed largely in the more porous Ap horizon for most of the recession and so required a much larger volume to be removed for a similar fall in the water table. (Baker-IVI)
W84-03433

ANALYZING FIELD-MEASURED SOIL-WATER PROPERTIES,
D. R. Nielsen, P. M. Tillotson, and S. R. Vieira.
Agricultural Water Management, Vol. 6, No. 2/3, p 93-109, 1983. 7 Fig, 46 Ref.

Descriptors: *Soil water, *Statistical methods, Reviews, Stochastic process, Model studies, Spatial distribution, Spectral analysis, Correlation analysis, Mathematical studies.

A qualitative review is offered of statistical concepts useful in the field of agricultural sciences. In the area of spatial and temporal dependence attention is given to spatial autocorrelation, spatial cross-correlation, spectral analysis, cospectral analysis, cospectral phase angles and coherence, semivariograms and kriging, and cross-semivariograms and cokriging. Concerning deterministic versus stochastic equations information is presented concerning scaling and stochastic equations. Of paramount importance in this field is the identification of criteria for choosing deterministic rather than stochastic algorithms for ascertaining the behavior of water in field soils. (Baker-IVI)
W84-03436

USE OF SOIL SURVEY DATA TO SELECT MEASUREMENT TECHNIQUES FOR HYDRAULIC CONDUCTIVITY,
J. Bouma.
Agricultural Water Management, Vol. 6, No. 2/3, p 177-190, 1983. 4 Fig, 4 Tab, 29 Ref.

Descriptors: *Permeability coefficient, *Soil properties, Soil water, Physical properties, Macropores, Saturated soils, Unsaturated soils, Soil types.

The selection of proper physical-measurement techniques as a function of different soil and site conditions is examined. The conditions are such as can be derived from soil-survey information. A comparison is offered of different operational aspects of measurement methods. Some arbitrarily selected examples are presented to illustrate the importance of soil and site conditions for selecting methods for measuring hydraulic conductivity. Sample size, soil swelling, occurrence of macropores in both saturated and unsaturated soils, and soil profiles are considered. (Baker-IVI)
W84-03437

A HEURISTIC MODEL OF SOIL WATER REGIMES IN CLAY SOILS IN THE PRESENCE OF MOLE DRAINAGE,
A. C. Armstrong.
Agricultural Water Management, Vol. 6, No. 2/3, p 191-201, 1983. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Soil water, *Drains, Mole drains, Drainage, Soil properties, Clays, Soil types, Heuristic model, Model studies.

Soil water regimes are considered as they affect agriculture either through affects on plant growth or on the farmer's ability to use the land. A clay soil is considered as a two phase system, in which there is rapid movement within a system of structural passages (macropores) which have a relatively low volume in the soil mass but a high conductivity, and a far more extensive but much less conductive system of micropores. The proposed model is intended as a heuristic device to explore the possibility of a two-phase model for predicting soil water regimes. Its criterion for success is the matching of observed and pedicted water table behavior and not the physical explanation it offers. The model divides into four major components: infiltration, water table modelling, the coupling model and surface storage. Preliminary results are offered using rainfall inputs for Okehampton in Devon running the model for a 200 day period from October to March using daily rainfall values. While a significant portion of the input to the micropore system is by infiltration from the macropores, this component does not dominate the response since it is only about 25% of the total input. A significant factor in maintaining high water tables very near the surface is the carry-over effect afforded by the storage of water on the surface. The implication must be that effective surface drainage, by removing this store, has a beneficial effect. (Baker-IVI)
W84-03438

REGIONAL FIELD STUDY OF THE SPATIAL VARIABILITY OF SELECTED SOIL PHYSICAL PROPERTIES,
A. G. Hornsby, J. M. Davidson, D. K. Cassel, and R. R. Bruce.
Agricultural Water Management, Vol. 6, No. 2/3, p 269-276, 1983. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Soil properties, *Spatial distribution, Physical properties, Soil water, Water management, Farming.

With increased interest in managing soil water for crop production in areas which rely primarily on rainfall to meet crop demands, a greater need exists to understand the spatial and temporal variability of soil hydraulic properties. This collection of field and lab data using standardized methods permits critical analysis of the appropriateness of the methods for a particular use and reveals those situations where the methods fail. The instantaneous profile method or the plane of zero flux method for determining in situ unsaturated hydraulic conductivity of field soils works well for most of the soil series examined in this study. Some difficulty was found in establishing a water saturated soil profile at some sites due to macropores which short-circuited the water through the profile and prevented the ponding process from thoroughly wetting the entire profile. A problem encountered at some sites was the inability to saturate the lower horizons which were located below a less permeable horizon and which usually had a higher clay content. Swelling of the undisturbed soil cores used to measure bulk density and the soil-water retention curves contributed to measurement errors of these two parameters. (Baker-IVI)
W84-03441

WHEAT ROOT GROWTH, GRAIN YIELD AND WATER UPTAKE AS INFLUENCED BY SOIL WATER REGIME AND DEPTH OF NITROGEN PLACEMENT IN A LOAMY SAND SOIL,
Indian Grassland and Fodder Research Inst.. Jhansi.
For primary bibliographic entry see Field 2I.
W84-03445

PROBABILITY OF WATERLOGGING ESTIMATED FROM HISTORICAL RAINFALL RECORDS,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experiment Unit.
C. W. Dennis, and J. Grindley.
Agricultural Water Management, Vol. 6, No. 4, p 397-401, 1983. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Waterlogging, *Rainfall, *Probability, Soil water, Drainage, Cambridge, England.

The usual method of operating the lysimeter facility at the Letcombe Laboratory (Great Britain) has been to apply large amounts of artificial rainfall over a short period of time in order to achieve the onset of sharp, well defined waterlogging events. This has presented the problem of assessing the likelihood in the field of the various simulated rainfall applications which the experimental program has used. The probability of waterlogging occurring on a given date may be calculated from meteorological records, provided that certain soil properties are known. In essence the method involves ascertaining the return period for a given fraction (either greater or smaller than unity) of the average rainfall in the period between arrival at or departure from field capacity and the particular date of interest. Due to the normal presence of some sort of drainage, the values obtained may be regarded as minima. The area around Cambridge, England is used in a demonstration of the method. (Moore-IVI)
W84-03446

DIRECT PARAMETER IDENTIFICATION OF FRACTURED POROUS MEDIUM,
Princeton Univ., NJ. Dept. of Civil Engineering.
V. V. Nguyen.
Advances in Water Resources, Vol. 6, p 11-14, March, 1983. 3 Fig, 1 Tab, 6 Ref. Department of Energy contract DE-AC03-80SF11489.

Descriptors: *Porosity, Piezo-conductivity, Conductivity, Transmissivity, Mathematical equations, Model studies.

A direct method of parameter identification for a fracture porous medium can be formulated. The coefficient of piezo-conductivity and the virtual fracture transmissivity can be determined using a combination of graphical methods and approximate formulae. Field calculation provides a practical demonstration of the proposed approach. In contrast to the type-curve approaches currently known in the literature, this simple procedure may be viewed as an alternative to field practitioners. (Baker-IVI)
W84-03457

TRANSPORT OF WATER IN FROZEN SOIL. II. EFFECTS OF ICE ON THE TRANSPORT OF WATER UNDER ISOTHERMAL CONDITIONS,
Cold Regions Research and Engineering Lab., Hanover, NH.
Y. Nakano, A. Tice, J. Oliphant, and T. Jenkins.
Advances in Water Resources, Vol. 6, No. 1, p 15-26, March, 1983. 11 Fig, 2 Tab, 16 Ref.

Descriptors: *Water transport, *Soil water, *Frozen ground, Ice, Mathematical analysis, Soil properties, Clays.

It is known that water in frozen soil generally exists in three phases: vapor, liquid (absorbed water) and ice. In liquid phase water in frozen soil is often referred to as unfrozen water. The unfrozen water content mainly depends on the soil type and temperature although unfrozen water versus temperature curves usually exhibit minor hysteresis depending on cooling and warming cycles. Experimental results obtained using Morin clay at minus 1.0 degrees C, showed that the presence of ice significantly affects the transport of water. A strong correlation exists between the flux of water and the gradient of total water content. A theoretical analysis of the experimental results and a dis-

cussion of a possible mechanism for water transport in frozen soil are presented. (Baker-IVI)
W84-03458

THE SOIL-MOISTURE ZONE IN A PHYSICALLY-BASED HYDROLOGIC MODEL,
Waterloopkundig Lab., Delft (Netherlands).
B. H. Gilding.
Advances in Water Resources, Vol. 6, No. 1, p 36-43, March, 1983. 6 Fig, 24 Ref.

Descriptors: *Hydrologic models, *Soil water, *Aeration zone, Mathematical models, Unsaturated flow, Soil-water-plant relationships.

An approach to modelling the unsaturated soil-moisture zone in the framework of an integrated physically-based hydrologic response model was developed. The subsurface flow regime may be viewed as two separate entities: a saturated flow system which may be modelled by standard two-dimensional regional techniques, and a single overlying unsaturated zone in which the flow is essentially vertical. Coupling takes place via the definition of saturation at the lower boundary of the unsaturated zone, and via a conservative water balance. Attention is focused on the computational procedure for the unsaturated zone as a self-contained module. The major difficulties are the definition of the interface between the saturated and unsaturated zones, the nonlinear character of the equation used to describe unsaturated flow, the inclusion of realistic atmospheric boundary conditions, and, the interaction between water uptake by plants and available soil-moisture. The complete numerical technique is non-iterative, and is based upon the use of a predictor and corrector at each time-step. The computational procedure yields the soil-moisture distribution, actual infiltration or surface evaporation, and actual water uptake by plants as functions of time with specified initial and potential values as input. (Moore-IVI)
W84-03459

SOIL MORPHOLOGY AND WATER REGIMES IN 3 RECENT ALLUVIAL SOILS ON THE TAIERI PLAINS, SOUTH ISLAND, NEW ZEALAND,
Department of Scientific and Industrial Research, Dunedin (New Zealand). Soil Bureau.
S. M. Smith, and F. G. Beecroft.
New Zealand Journal of Science, Vol. 26, No. 3, p 403-411, 1983. 2 Fig, 3 Tab, 18 Ref, 1 Append.

Descriptors: *Soil water, *Soil morphology, *South Island, *New Zealand, Soil water table, Seasonal variation, Matrix color.

An assessment of soil morphology and water regimes of 3 recent alluvial soils on the Taieri Plains, South Island, New Zealand, is described. The pattern of soil water table fluctuations follows a yearly sigmoidal cycle. With increased duration of saturation, mottles tend to decrease in size and abundance and have more diffuse boundaries. The matrix colors of the soil horizons, in conjunction with the nature of the mottles, broadly reflect the different moisture regimes at the 3 sites although the distinction between imperfectly and poorly drained soils is not clear. Moisture regimes as used by the Soil Survey of England and Wales successfully separated the soils into distinctive (quantified) classes. Soil Taxonomy separated the 2 wetter members of the sequence, but does not quantify the duration of saturation. Further research is needed to develop a system of soil moisture regime classification in New Zealand if soil survey interpretations are to be expanded. (Author's abstract)
W84-03485

2H. Lakes

THE NATURAL HISTORY OF A NEARCTIC TEMPORARY POND IN ONTARIO WITH REMARKS ON CONTINENTAL VARIATION IN SUCH HABITATS,
Toronto Unv. (Ontario). Div. of Life Sciences.
D. D. Williams.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 2, p 239-253, 1983. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Invertebrates, *Ponds, *Temporary ponds, Population dynamics, Seasonal variations, Ontario, British Columbia, Model studies, Fauna.

Physical, chemical and faunal characteristics of a temporary vernal pond in southern Ontario, Canada are given. As the pond water evaporated temperature and conductivity rose while pH varied. Ninety-eight taxa were identified which showed seasonal succession over the annual cycle of the pond. Five recognizably distinct faunal groups, based on time of appearance and period of activity, were apparent. Group 1 animals were found during the entire aquatic phase. Group 2 animals were active within days of the pond filling in the spring and completed their life cycle within 4-6 weeks. Group 3 animals appeared 2-5 weeks after filling and typically took 5 weeks to mature. Species in Group 4 were evident only 2-3 week before the pond dried up and exhibited rapid growth. Group 5 animals appeared in the dry phase and included primarily terrestrial and riparian species. Community composition is analyzed in terms of trophic status of each taxon. This indicates shifts which were appropriate for seasonal changes in the pond's potential food resources. The taxonomic composition of the spring time fauna of this pond was compared with that of a very similar pond 2,400 km to the west, on Vancouver Island, British Columbia. The number of species in each major taxon was frequently identical in the two ponds. In addition, the faunas had 23 genera and 6 species in common. These two faunas are compared with a predictive model of the fauna compliment of annual temporary pools. (Baker-IVI)
W84-02952

PELAGIC DIATOM POPULATIONS IN LENTIC FRESHWATER MICROCOSMS,
California Univ., Berkeley. Lawrence Berkeley Lab.
J. Harte, D. Levy, and J. T. Rees.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 2, p 255-267, 1983. 3 Fig, 5 Tab, 23 Ref.

Descriptors: *Diatoms, *Population dynamics, *Lentic environment, Phytoplankton, Comparison studies, Epilimnion.

Three experiments, involving simultaneous monitoring of selected biological and chemical parameters in 50 l laboratory microcosms and the epilimnia of their parent reservoirs, from the autumn of 1978 to the winter of 1980 (lasting 8-13 weeks), ascertained the degree of similarity between laboratory and field systems. Microcosm dynamics, specifically diatom dynamics, most closely paralleled that found in reservoirs during late spring and early summer, a time of thermal stratification. During winter months when thermal stratification was absent or less pronounced, microcosm diatom populations diverged significantly from reservoir populations within 24 days. Microcosm design and operating conditions have a major bearing on microcosm usefulness for environmental assessment. (Murphy-IVI)
W84-02953

PRODUCTION AND ECOLOGY OF BENTHIC CHIRONOMID LARVAE (DIPTERA) IN LAKE HAYES, NEW ZEALAND, A WARM-MONOMICTIC EUTROPHIC LAKE,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
A. A. Graham, and C. W. Burns.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 3, p 351-377, 1983. 10 Fig, 11 Tab, 56 Ref.

Descriptors: *Chironomid larvae, *Lake Hayes, *New Zealand, *Eutrophic Lake, Midges, Population dynamics, Benthic fauna, Phytoplankton, Organic matter, Ecological distribution, Aquatic productivity.

The benthic fauna of eutrophic lakes is usually dominated by chironomid larvae which, by their burrowing, respiration and excretion, may aid nutrient cycling in lakes and are also important as fish food. From December 1973 to March 1975 the mean annual production of the two dominant species, Chironomus zealandicus and Chironomus sp. a, was 29.2 g/sq m dry weight which is approximately 4.3% of the average annual phytoplankton production in the lake. A high annual P/B ratio of 18.5 is consistent with the multivoltine life cycle of C. zealandicus. Larval chironomid production in the second summer when Anabaena blooms were absent was only one quarter of that in the first summer and is consistent with the hypothesis that the production of benthic chironomids in Lake Hayes is closely linked to that of the phytoplankton through the sedimentation of autochthonous organic matter. (Murphy-IVI)
W84-02955

ESTIMATES OF MICROBIAL POPULATIONS INVOLVED IN THE N CYCLE AND THEIR ACTIVITY IN WATER AND SEDIMENTS OF FISH FARMING PONDS UNDER MONO- AND POLYCULTURE SYSTEMS IN INDIA,
Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and S. K. Roy.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 4, p 581-590, 1983. 6 Fig, 22 Ref. Indian Council of Agricultural Research grant 11(8)-76-ASR(I).

Descriptors: *Bacteria, *Population density, *Nitrogen cycle, *Fish farming, *Fish ponds, *Monoculture, *Polyculture, Ammonification, Nitrification.

Spatial differences in the microbial density of ammonifying, protein mineralizing, nitrogen fixing and nitrifying bacteria, and the rates of ammonification and nitrification (natural and potential) in water and sediments of four fish ponds used for traditional, mono- and polyculture systems of fish farming were related to the fish culturing practices adopted. The seasonal variation of ammonifying bacteria was positively correlated with the NH4-N level in the water. The natural and potential capacity to generate both nitrite and nitrate in these water bodies was strongly correlated with the concentrations of the different forms of inorganic nitrogen present. The rates of NO2-N and NO3-N formation occurring in these fish ponds were directly proportional to the amount of dissolved oxygen and pH of the environment, respectively. (Murphy-IVI)
W84-02958

A STUDY ON THE MACRO-ZOOBENTHOS AND THE PHYSICO-CHEMICAL CHARACTERISTICS OF THE BOTTOM OF BAKHIRA LAKE, UTTAR PRADESH, INDIA,
Gorakhpur Univ. (India). Dept. of Zoology.
K. Pandey, R. Shyam, S. Prasad, and H. S. Chaudhry.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 4, p 591-597, 1983. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Benthic fauna, *Physicochemical properties, *Bottom sampling, *Bakhira Lake, Population dynamics, Bottom water.

Bakhira Lake is the largest man-made lake of Eastern Uttar Pradesh. It is utilized for Boro (coarse paddy) cultivation, irrigation and fishing by poor village farmers. The lake is a combination of ten tals (large basins), and has no regular gradation in depth. Hydrographical features, qualitative and quantitative composition of the macro-zoobenthos, and the physico-chemical characteristics of the bottom water and sediment were studied from October 1976 to April 1977. Mollusks, insects, ostracods, annelids, nematodes and crusaceans are the main groups of zoobenthos. Mollusks together with insects dominate the benthic fauna (95.2 to 96.4% of numbers). The average density of macro-zoobenthos is more or less inversely related to the total alkalinity of the bottom water. Mollusks showed a positive correlation to temperature and a

negative correlation to insect density. (Murphy-IVI)
W84-02959

THE DISTRIBUTION OF DESMOGNATHINE LARVAE (AMPHIBIA: PLETHODONTIDAE) IN COAL SURFACE MINE IMPACTED STREAMS OF THE CUMBERLAND PLATEAU, USA,
Tulsa Univ., OK. Faculty of Natural Sciences.
J. A. Gore.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 13-23, March, 1983. 3 Fig, 2 Tab, 32 Ref.

Descriptors: *Streams, *Acidity, *Benthic environment, Population dynamics, Water pollution effects, Mine drainage, Mine wastes, Iron pyrite, Metals, Turbidity, Shading, Light intensity, Vegetation effects.

Selected water quality parameters of streams in the Cumberland Plateau area of Kentucky, Tennessee, and Alabama and their relationship to the occurrence of desmognathine larvae are considered. Higher densities of larvae were found in streams with greater than 80% overhead vegetation (less than 20% direct insolation). These streams with high overhead vegetation, therefore shaded, values were also those of the lowest stream order and discharge. There were no trends observed with regard to temperature of the water and dissolved oxygen concentrations, which were near to saturation levels for all streams studied. (Baker-IVI)
W84-02961

THE DESMIDS AND PHYSICAL CHARACTERISTICS OF 100 LAKES IN NORTHEASTERN PENNSYLVANIA,
Wilkes Coll., Wilkes-Barre, PA.
C. B. Reif, B. B. Smith, and A. Case.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 25-36, March, 1983. 4 Tab, 40 Ref.

Descriptors: *Lakes, *Species diversity, *Acid rain, *Desmids, *Pennsylvania, Water pollution effects, Bear Creek, Acidity, Sodium, Potassium, Magnesium, Calcium, Conductivity.

Paired samples taken from 100 lakes during July of 1980 were examined for desmids and analyzed chemically. The lakes lie in an area roughly one hundred km by fifty km within northeastern Pennsylvania. Elevations above mean sea level range from 289 m to 624 m. Harveys Lake, with an area of 280 hectares, is the largest natural lake, by volume, in the state. Lakes Henry and Ladore also exceed 100 hectares but the other 97 were smaller. From each lake two samples were taken in the littoral zone close to vascular aquatic plants. Simple linear regression analyses comparing desmids with pH, conductivity, alkalinity, calcium, magnesium, sodium, and potassium indicated very little statistical correlation between numbers of species and any single chemical factor. Stepwise regression for pairs of chemical values produced highest R-square for pH and magnesium but not positively significant. (Baker-IVI)
W84-02962

FORAGE FISH ASSEMBLAGES IN THE BRAZOS RIVER UPSTREAM AND DOWNSTREAM FROM POSSUM KINGDOM RESERVOIR, TEXAS,
North Texas State Univ., Denton. Inst. of Applied Sciences.
K. A. Anderson, T. L. Beitinger, and E. G. Zimmerman.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 81-88, March, 1983. 1 Fig, 2 Tab, 16 Ref. OWRT grant (B-22-TEX).

Descriptors: *Forage Fishes, *Population dynamics, *Brazos River, *Possum Kingdom Reservoir, Fish populations, Ecosystems.

River impoundments can affect downstream biological communities by changing temperature regimes, flow rates, substrate, water quality and nutrient availability. Metabolism of dissolved substances in lentic waters can lead to reduced nutrient availability and changes in water solute concentrations in water discharged from reservoirs. The forage fish assemblages of the Brazos River was sampled at one location above and four locations below Possum Kingdom Reservoir each month for one year. A total of 13,936 individuals representing 18 species, 14 genera and five families were collected. Five of these species, Notropis stramineus, Notropis atherinoides, Hybognathus placitus, Hybopsis aestivalis and Cyprinodon rubrofluviatilis were found only upstream from Possum Kingdom Reservoir. Hybognatus placitus accounted for 45% of fish captured at the upstream site. In contrast, nine species were collected exclusively in the tailwaters, including Etheostoma spectabile, Percina sciera, Campostoma anomalum, Notropis venustus, Pimephales notatus, Labidesthes sicculus and Fundulus notatus. Only four species were obtained at all five stations -- Gambusia affinis, Menidia beryllina, Pimephales vigilax and Notropis lutrensis. N. lutrensis was the most common tailwater species equalling 87.9% of the total downstream catch. Median species diversity indices ranged from 0.129 to 0.451 for the five stations, with the highest value at the upstream station. Coefficients of biotic similarity ranged from 0.20 to 0.62, with the upstream station clearly being the most dissimilar. These findings are discussed relative to environmental effects of hypolimnetic release of reservoir waters. (Murphy-IVI)
W84-02964

CHANGES IN THE CHIRONOMID (DIPTERA: CHIRONOMIDAE) FAUNA OF LAUREL CREEK RESERVOIR, WATERLOO, ONTARIO,
Waterloo Univ. (Ontario). Dept. of Biology.
T. W. Sephton, B. A. Hicks, C. H. Fernando, and C. G. Paterson.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 89-102, March, 1983. 3 Fig, 5 Tab, 49 Ref. NSERC grants A-3478 and A-6299.

Descriptors: *Population dynamics, *Laurel Creek Reservoir, *Waterloo, *Ontario, *Chironomids, Reservoirs, Eutrophication, Trophic level, Dissolved oxygen.

Qualitative and quantitative changes in the chironomid fauna of Laurel Creek Reservoir are presented as they were determined over the 13 years of its existence. A substantial decrease is noted in the average numerical abundance from 1967 to 1968, from 6303/sq m to 3373/sq m, and it has remained stable since 1975 to 1980. Distinct changes were noted in the faunal numerical abundance, although the genera have remained the same. In 1967, the Chironomini comprised 95% of the total throughout the year. In 1968, the Chironomini dominated with 68%, the Tanytarsini increased to 24% and the Tanypodinae at 6% and Orthocladiinae at 2% remained low. In 1975 the Chironomini accounted for 72% and the Tanypodinae increased to 21%, the Tanytarsini decreased to 5%, and the Orthocladiinae remained low at 2%. By 1980 the Tanypodinae had become dominant at 60% while the Chironomini had become dominant at 60% while the Chironomini had decreased to 38%. The Tanytarsini and Orthocladiinae were insignificant at 1% each. The decreased standing stock and changes in the dominance hierarchy of the chironomid fauna are associated with changes in the trophic level of the substrate conditions and bottom oxygen levels of the reservoir. Laurel Creek Reservoir has not entered a state of advanced eutrophy. (Baker-IVI)
W84-02965

ALKALINITY, DISCHARGE, AVERAGE VELOCITY, AND INVERTEBRATE DRIFT CONCENTRATION IN SUBARCTIC ALASKAN STREAMS,
Alaska Univ., Fairbanks. Inst. of Water Resources.
J. D. LaPerriere.
Journal of Freshwater Ecology, Vol. 2, No. 2, p 141-151, July, 1983. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Invertebrates, *Streams, *Alaska, Alkalinity, Velocity, Sediment transport, Invertebrate drift, Insects, Flow discharge.

The associations of alkalinity, current and invertebrate drift among 13 streams were measured in subarctic Alaska. A significant positive correlation was noted between alkalinity and drift concentrations expressed as numbers per unit volume. Significant inverse relations were found between stream discharge and drift concentration expressed as either numbers or weight. This dilution was to be expected as stream wetted perimeter, the source of invertebrates to drift, increases as approximately the square root of the discharge. Multiple regression analysis also showed a positive relation between stream average velocity and drift concentrations. Invertebrate drift was seen, therefore, to be somewhat analogous to sediment transport in streams. Most of the drift samples were numerically dominated by Diptera. Ephemeroptera usually were next in numbers, and Trichoptera and Plecoptera alternated in being third most numerous. (Baker-IVI)
W84-02969

LIMNOLOGICAL FEATURES OF SOME NORTHWESTERN FLORIDA LAKES,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
D. E. Canfield, Jr., M. J. Maceina, L. M. Hodgson, and K. A. Langeland.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 67-79, March, 1983. 2 Fig, 7 Tab, 34 Ref.

Descriptors: *Limnology, *Sandhill lakes, *Florida, Mirrow Lake, Lake McKenzie, Turkey Pen Pond, Compass Lake, Round Lake, Crystal Lake, Dunford Pond, Gap Pond, Merial Lake, Chlorophyll, Chemical analysis, Acidity, Water quality, Oligotrophic lakes.

A limnological survey was undertaken of some sandhill lakes in Florida to assess their present limnological conditions. Nine lakes in all were examined. Mean depth ranged from 6.3 to 27 m. Secchi disc values ranged from 3.2 to 8.1 m. Thermal stratification occurred in all lakes. Chemically the lakes were characterized as acidic, soft-water lakes of low mineral content. Average total phosphorus values ranged from 3.1 to 10 mg/cu m, and average chlorophyll a values ranged from 0.5 to 1.4 mg/cu m. These are among the most oligotrophic lakes in Florida. It is felt that anthropogenic activities have had very little influence on these present conditions. The Lakes studied were Compass Lake, Crystal Lake, Dunford Pond, Gap Pond, Lake McKenzie, Merial Lake, Mirrow Lake, Round Lake, and Turkey Pen Pond. (Baker-IVI)
W84-02971

COMMENTS CONCERNING 'CONVECTION PATTERNS IN A POND',
Hawaii Univ., Honolulu. Dept. of Oceanography.
For primary bibliographic entry see Field 2C.
W84-02981

NITROGEN FIXATION AND PHOSPHORUS TURNOVER IN A HYPERTROPHIC PRAIRIE LAKE,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
B. G. Brownlee, and T. P. Murphy.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 1853-1860, November, 1983. 3 Fig, 5 Tab, 27 Ref.

Descriptors: *Nitrogen fixation, *Phosphorus removal, *Hypertrophic lakes, Carbonates, Ammonia, Nitrogen cycle, Algae, Aphanizomenon, Manitoba, Eutrophication, Prairies.

Nitrogen fixation by Aphanizomenon flos-aquae in a prairie lake in southwestern Manitoba was dependent on the light intensity and in situ oxygen concentrations. The mean molar ratio of acetylene reduction to nitrogen reduction was 5.8:1. High external ammonium concentrations did not appear to inhibit nitrogen fixation over the short term. Nitrogen fixation was not directly initiated by the bloom collapse. The sequence of ammonia volatilization and nitrogen fixation was triggered by the bloom collapse and the bloom collapse was caused by coprecipitation of orthophosphate with carbon-

ates. PO4 turnover was most rapid during periods when the lake was opalescent, presumable due to carbonate precipitation. (Murphy-IVI)
W84-03015

A NEW APPROACH TO ESTIMATING POPULATIONS BY THE REMOVAL METHOD,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
J. Schnute.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p 2153-2169, December, 1983. 2 Fig, 5 Tab, 17 Ref, 5 Append.

Descriptors: *Fish populations, *Model studies, Populations, Mathematical models, New Brunswick, Estimating.

This new approach to the use of removal data in estimating the size of a population of fish or other animals admits a variety of assumptions on how catchability varies among fishings including the assumption of constant catchability. The methods hinge on maximum likelihood estimation, and can be used both to decide objectively if the data justify rejecting constant catchability and to determine confidence intervals for the parameters. A new method of assigning confidence to the population estimate points out problems with methods currently available in the literature. The theory is applied both to data in historical literature and recent data from streams in New Brunswick, Canada, which demonstrate that constant catchability can frequently lead to serious errors in data interpretation. In some cases, the conclusion that the population size is well known may be blatantly false, and reasonable estimates may be impossible without further data. (Murphy-IVI)
W84-03022

A STOCHASTIC AGE-STRUCTURED POPULATION MODEL OF STRIPED BASS (MORONE SAXATILIS) IN THE POTOMAC RIVER,
Rockefeller Univ., New York.
J. E. Cohen, S. W. Christensen, and C. P. Goodyear.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p 2170-2183, December, 1983. 1 Fig, 2 Tab, 37 Ref. NCF grant DEB80-11026, NIMH grant 5T32MH14581-06.

Descriptors: *Stochastic process, *Fish populations, *Bass, *Potomac River, Morone, Mathematical models, Fish management, Statistical analysis, Spawning.

Deterministic age-structured models of fish populations neglect apparently stochastic fluctuations in the catch per unit effort of yearlings and of adult fish. A model is needed for an age-structured population in which the survival and egg-laying are constant. For such a stochastic model, two measures of the long-term population growth rate are the average growth rate of the population size and the growth rate of the average population size. Both measures are computed analytically for a simplified model representing only eggs and reproductive adults. For a model of the striped bass population spawning in the Potomac River, both point and interval estimates of the growth rate of the average population size are computed. These models can be used as a framework for modeling stochastic variation of vital rates in real age-structured populations. (Murphy-IVI)
W84-03023

MODEL OF MISSISSIPPI RIVER POOL: DISSOLVED OXYGEN,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Civil and Environmental Engineering.
A. C. Demetracopoulos, and H. G. Stefan.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1020-1034, October, 1983. 8 Fig, 33 Ref.

Descriptors: *Mathematical models, *Mississippi River pool, *Dissolved oxygen, Photosynthesis, Respiration, Biochemistry, Biomass, Hydrologic models, Hydraulic transportation.

Dissolved oxygen (DO) describes the general health of a water body and is a quality varible that reflects the capacity of the system to support a balanced aquatic habitat. Biochemical oxygen demanding material (BOD) suspended or dissolved in the water (including waste), oxygen demanding material on the river bottom (Sedimentary oxygen demand, SOD) and respiratory requirements of the phytoplankton are the primary sink terms utilizing DO in a natural water body. The source/sink terms are very important for dissolved oxygen under low summer flow conditions. A simulation of dissolved oxygen (DO) dynamics and of biomass is incorporated in a dynamic wind and gravity driven hydrologic transport model. Photosynthesis introduced a diurnal cycle on the dissolved oxygen concentration, wich was sometimes very noticeable and sometimes obscured by other physical and biochemical processes. (Murphy-IVI)
W84-03085

GAS-FILM COEFFICIENTS FOR STREAMS,
Geological Survey, NSTL Station, MS.
R. E. Rathbun, and D. Y. Tai.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1111-1127, October, 1983. 1 Fig, 2 Tab, 36 Ref.

Descriptors: *Gas-film coefficients, Streams, Mathematical equations, Prediction, Organic compounds, Organic loading, Volatilization, Fate of pollutants.

Understanding the volatilization process is necessary for predicting correctly the fate of many organic compounds in streams and rivers. The volatization is frequently described by the two-film model. The film coefficient is a function of windspeed and water temperature. The dependence of the coefficient on windspeed is determined from published information on the evaporation of water from a canal. The dependence of the coefficient on temperature is determined from laboratory studies on the evaporation of water. Procedures for adjusting the coefficients for different organic solutes are based on the molecular diffusion coefficient and the molecular weight. The molecular weight procedure is easiest to use because of the availability of molecular weights. However, the theoretical basis of the procedure is questionable. The diffusion coefficient procedure is supported by considerable data. Questions, however, remain regarding the exact dependence of the film coefficient on the diffusion coefficient. The diffusion coefficient procedure with a 0.68-power dependence should be used when precise estimate of the gas-film coefficient are needed and the molecular weight procedure be used when only approximate estimates are needed. (Murphy-IVI)
W84-03090

RESERVOIR CIRCULATION PATTERNS AND WATER QUALITY,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
B. R. Kim, J. M. Higgins, and D. J. Bruggink.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1284-1293, December, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Reservoirs, *Water circulation, *Water quality, Model studies, Mathematical models, Hypolimnion, Metalimnion, Wastewater outfall, Wastewater dilution, Hydrodynamics, Hydrological regime.

A two-dimensional hydrodynamic-temperature model examines the similarities between circulation patterns and observed water quality phenomena in Cherokee Reservoir. A circulation pattern, involving reverse bottom flows which occurred during March through July, most likely influenced high fecal coliform concentrations in the water supply intake (located in the reservoir upstream of a wastewater outfall), depressed dissolved oxygen concentrations in the metalimnion and the development of dissolved oxygen depletion in the hypolimnion. The potential effects of reservoir circulation suggest that reservoir operations might be used as one means of influencing water quality profiles within the reservoir. (Murphy-IVI)
W84-03094

PHYTOPLANKTON MODELING IN THE EMBAYMENTS OF LAKES,
National Taiwan Univ., Taipei. Dept. of Civil Engineering.
J.-T. Kuo, and R. V. Thomann.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1311-1332, December, 1983. 11 Fig, 4 Tab, 29 Ref. EPA grant R803680030.

Descriptors: *Phytoplankton, *Mathematical models, *Lake embayments, Water quality, Finite element method, Comparison studies, Hydrodynamics, Water circulation, Rochester embayment, Lake Ontario.

A steady-state, finite-element lake circulation model generates mean circulation patterns in homogeneous lakes. This coupled model applied to Rochester Embayment, Lake Ontario during the nonstratification period and to Saginaw Bay, Lake Huron, has the advantage of reducing a considerable amount of computer time when compared to the use of a transient hydrodynamic model for water quality modeling. The model can calculate large-scale dispersion and turbulent exchange coefficients from detailed velocities calculated from the finer-scale lake circulation model around the coarser water quality segments. Water current outputs and constituent concentration are sensitive to the change of vertical eddy viscosity, drag coefficient on the water surface, and wind data for the circulation model. (Murphy-IVI)
W84-03095

REAERATION AND VERTICAL DIFFUSION OF LAKE OXYGEN,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1419-1423, December, 1983. 2 Tab, 15 Ref.

Descriptors: *Lakes, *Aeration, Oxygen, Diffusion, Mathematical study, Air-water interfaces, Dissolved oxygen.

The interaction between the reaeration coefficient of oxygen across the atmosphere-water interface, k (m/day), and the veritcal diffusivity coefficient in the surface waters of the lakes and reservoirs, D (sq m/day), may act as controllers upon the oxygen profile. Factors influencing the shape and sensitivity of oxygen profiles of epilimnetic waters analyzed quantitatively using steady-state models was prompted by discrepancies in the sensitivity of oxygen model predictions to variations in the reaeration coefficient. For example, an oxygen model is expected to be insensitive to a reaeration coefficient greater than 1 m/day if the vertical diffusivity coefficient is less than ca 1 sq m/day. The influence of other combinations of reaeration coefficient and vertical transport rate upon observed oxygen concentrations can be analyzed using models expressed. (Murphy-IVI)
W84-03098

USE OF TIME-SERIES ANALYSIS TO DEMONSTRATE ADVECTION RATES OF DIFFERENT VARIABLES IN A SMALL LAKE,
McMaster Univ., Hamilton (Ontario). Dept. of Biology.
A. M. Trimbee, and G. P. Harris.
Journal of Plankton Research, Vol. 5, No. 6, p 819-833, 1983. 11 Fig, 1 Tab, 28 Ref.

Descriptors: *Time series analysis, *Advection, *Multivariable analysis, Algal growth, Interfaces, Weather, Phosphorus, Guelph Lake.

In algal ecology, attempts to seek direct correlations between environmental factors and algal abundance at one point in time or space will fail if non-equilibrium conditions occur and time lags exist between the environmental change and the phytoplankton response. Time-series analysis of daily data from 3 stations in a small lake demonstrates the existence of strong horizontal advection within the basin at a time scale of 2-3 d and longer term periodicities (10-20 d) associated with the

passage of atmospheric weather systems. Fluctuations in integral SRP concentrations at station 1 (outflow end) consistently occurred 3 d later than at station 3 (inflow end). The algal biomass (chlorophyll a) at station 1 lagged that at station 3 by half a day. The time lag between station 1 and station 3 for Aphanizomenon flos-aquae was 7 d, whereas for Ceratium hirundinella station 1 led station 3 by 3 d indicating motion by the species in opposite directions. The distribution of the algal biomass in space and time was a composite of the individual species patterns. The periodicities in the average daily wind speed and water column stability were likely due to periods of vertical mixing. The use of chlorophyll as a measure of biomass hides much important information about the changing species composition of the assemblage. The characterization of these important mixing scales is a necessary preliminary step in understanding the phytoplankton dynamics of the system. (Murphy-IVI)
W84-03102

ROLE OF CURRENT ON THE DISTRIBUTION OF JUVENILE FISHES IN RESERVOIRS,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. K. Konobeeva.
Journal of Icthylogy, Vol. 23, No. 1, p 96-102, 1983. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Fish, *Reservoirs, *Water currents, Fish behavior, Rybinsk Reservoir, Ivan'kovo Reservoir, Velocity, Wind.

An attempt was made by labeling of the water masses and juvenile fishes and observations on their movement, to explain the role of current in the distribution of juvenile fishes in reservoirs using examples of Rybinsk and Ivan'kovo reservoirs. While many factors influenced the movement of young fish in the reservoirs, the water current was definitely the major one. Juvenile phytophilous fishes at early stages of development can be carried by the current from the spawning ground into the open part of the reservoir. Larvae at development stages Al-E move in the open part of the lake and canal type reservoirs strictly with the watermass. In Rybinsk Reservoir (lake type), the fingerlings (standard length from 42-120 m) may drift not only passively in the water column but can also resist the current and move in a different direction over large distances irrespective of the velocity and direction of the current. In Ivan'kovo Reservoir which is of the canal type, not only the larvae but also advanced juveniles of 63-75 mm move with the watermass. This is probably due to high current velocity and its constant direction. (Baker-IVI)
W84-03104

OOGENESIS OF THE RYBINSK RESERVOIR BREAM, ABRAMIS BRAMA (CYPRINIDAE),
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
A. M. Andreyeva.
Journal of Icthyology, Vol. 23, No. 2, p 74-78, 1983. 2 Fig, 8 Ref.

Descriptors: *Fish, *Reservoirs, Rybinsk Reservoir, Bream, Temperature effects, Distribution, Population density.

The annual sexual cycle of the bream, Abramis brama, of Rybinsk Reservoir and the duration of the individual stages of gonad maturity in specimens from different arms of the reservoir may be due to different temperature regimes. The bream is a major commercial species in the reservoir. The differences discovered in the annual sexual cycle of bream females from the Volga arm on the one hand and from the Mologa and North Sheksna arms on the other are further evidence of the existence in a single body of water such as Rybinsk Reservoir, of local bream populations previously found by tagging studies. Times and places of spawning, due to a different geographic position and hydrologic conditions of the body of water, are mainly responsible for the isolation of populations, although for a large part of the year individual fish groupings may also occupy common foraging and possibly overwintering areas. (Murphy-IVI)
W84-03105

THE INFLUENCE OF FLOW TURBULENCE ON FISH BEHAVIOR,
Akademiya Nauk SSSR, Moscow. Nauchnyi Sovet po Neorganischeskoi Khimii.
L. G. Shtaf, D. S. Pavlov, M. A. Skorobogatov, and A. Sh. Barekyan.
Journal of Icthyology, Vol. 23, No. 2, p 129-140, 1983. 6 Fig, 7 Tab, 9 Ref.

Descriptors: *Fish behavior, *Turbulence, Fish, Streamflow, Velocity, Water currents.

The flow of water, as the environment inhabited by fish, has a strong influence on their behavior. The fish select zones with a heightened degree of turbulence, on places of concentration, swimming capacity, compactness of schools of fish in currents with varying turbulence characteristics, and degree of orientation of fish at speeds close to threshold, depending on the flow movement regime. The duration of swimming of the roach depended on the degree of flow turbulence with the increase in the intensity of turbulence bringing about a decrease in turbulent flow. At speeds close to threshold, the degree of orientation of the fish depended on the conditions of flow movement. In turbulent flow the fish more readily orient in the direction of the velocity vector than in laminar flow. (Murphy-IVI)
W84-03106

TOXICITY OF CYANOBACTERIA IN DUTCH LAKES AND RESERVOIRS,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
P. Leeuwangh, F. I. Kappers, M. Dekker, and W. Koerselman.
Aquatic Toxicology, Vol. 4, No. 1, p 63-72, August, 1983. 1 Fig, 5 Tab, 16 Ref.

Descriptors: *Toxicity, *Cyanobacteria, *Lakes, *Reservoirs, Algal blooms, Scum, Hepatotoxins, Fast-death factor, Slow-death factor, Microcystis aeruginosa, Oscillatoria agardhii, Gloeotrichia echinulata.

Poisoning of livestock, pet animals, waterfowl and fish by waterblooms or scums of freshwater cyanobacteria has been reported in literature from 1878 onwards. Since then there have been numerous cases of toxic waterblooms leading to a considerable loss of animals in many countries around the world. The waterblooms and scums of Microcystis aeruginosa, Oscillatoria agardhii and Gloetrichia echinulata showed that M. aeruginosa hepatotoxin(s) were present in 9 out of 10 locations. By i.p. injection in mice the cyanobacterial endotoxin(s), the so-called Fast-Death Factor (FDF) or microcystin caused death in mice within 3 hours. In most samples associated bacterial toxin(s), the so-called Slow-Death Factor (SDF) causing death within 4 to 48 h were possibly involved in SDF intoxication symptoms and mortality. Suspensions of O. agardhii were also lethal. Syptoms and mortality can be attributed to at least two toxic factors. One resembling FDF, the other possibly resulting from associating bacteria. Administration of G. echinulata suspensions did not kill mice but produced symptoms of illness. The symptoms were not consistent with those of Microcystis FDF or SDF. (Murphy-IVI)
W84-03117

MACROBENTHIC FAUNA OF GREAT LAKE, ARTHURS LAKE AND LAKE SORELL, TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
W. Fulton.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 5, p 775-785, 1983. 2 Tab, 47 Ref.

Descriptors: *Benthic fauna, *Great Lake, *Arthurs Lake, *Lake Sorell, *Tasmania, Australia, Population dynamics, Population density, Ecosystems, Lake fisheries, Fish establishment.

Tasmanian lakes have similar numbers of species to comparable systems overseas. It is best to know as much as possible about Tasmanian lakes in order to provide a basis for fisheries management. The benthic fauna as well as each lake's characteristics can provide insight into fisheries management. The benthic fauna of Great Lake, Arthurs Lake and Lake Sorell, Tasmania, contained 88 species, with 48-55 species in each lake. All three lakes had abundant and generally similar chironomid faunas. Arthurs Lake and Great Lake shared common oligochaete species of which only some were numerous in Lake Sorell. The crustacean faunas of each lake differed in composition and abundance, with amphipod species being the most abundant group in Arthurs Lake. Gastropod mollusks were the most abundant group in the fauna of Lake Sorell, and chironomids were most numerous in Great Lake. (Murphy-IVI)
W84-03125

QUALITATIVE AND QUANTITATIVE VARIATION IN THE MACROBENTHIC FAUNA OF THE ORIGINAL LAKE AND NEW LAKE AREAS OF GREAT LAKE AND ARTHURS LAKE, TASMANIA,
Tasmania Univ., Hobart (Australia). Dept. of Zoology.
W. Fulton.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 5, p 787-803, 1983. 7 Fig, 6 Tab, 27 Ref.

Descriptors: *Qualitative analysis, *Quantitative analysis, *Benthic fauna, *Great Lake, *Arthurs Lake, *Tasmania, Australia, Lake morphology, Biomass, Water level fluctuations, Environmental factors, Ecosystems.

Faunal variation between sample sites in Great Lake and Arthurs Lake, using both qualitative and quantitative data could be useful in eventual fisheries management. Cluster analysis and principal coordinates analysis showed that the fauna of the original lake areas of both lakes is distinct from the fauna of the newly flooded areas. Closer relationships exist between the faunas of the old level of the two lakes than between the faunas of the old and new levels within either lake. The distinction is not attributable to depth but may be influenced by substrate differences. Abnormal fluctuations in water level may affect benthic populations in several ways. These include changes in water chemistry, elimination of macrophytes, alteration of substrates by erosion and exposure of substrates to air or ice cover. The sites at the old level were dominated by oligochaetes whereas chironomids contributed most to the sites at the new level. Consistent seasonal peaks were evident in the biomass at sites at the new level but not at sites at the old. The mean annual biomass levels (wet wt) for Great Lake (13.9 g/sq m) and Arthurs Lake (35.9 g/sq m) are comparatively above average values for other Australian and overseas lakes. (Murphy-IVI)
W84-03126

THE ALGAL COMMUNITIES OF THE UPPER BELGIAN MEUSE AND THE WATER QUALITY: A SYNTHESIS AT FALL 1981 (LES COMMUNAUTES ALGALES DE LA HAUTE MEUSE BELGE ET LA QUALITE DE SES EAUZ: UN BILAN A L'AUTOMENE 1981),
Liege Univ. (Belgium). Dept. of Botany.
J.-P. Descy.
Bulletin de la Society Royale de Botanique de Belgique, Vol. 116, No. 1, p 31-50, 1983.

Descriptors: *Meuse River, *Belgium, *Water quality, *Algae, Diatoms, Chrysophyta, Chlorophyta, Cyanophyta, Biomass, Plankton, Benthos.

In samples taken in the Upper Belgian Meuse in the autumn of 1981, 126 taxa of microscopic algae were identified in the plankton. The chrysophytes (almost all diatoms) and chlorophytes comprized 62.7 and 30.2%, respectively. Quantitative analysis of samples taken from three sites shows the same

trend, with a dominance of diatoms (60.6-64.7% of phytoplankton) and chlorophytes (27.9-34.0%). The remainder are almost all cyanophytes. There was a peak of biomass at the beginning of September, and a marked diminution at the beginning of October. The microphytobenthos included 122 taxa of diatoms (samples were taken between 1976-1981 from three sites). The dominant diatoms are basophilic species of biotypes 4 and 5. The majority of the taxa are pollution-sensitive, demonstrating good water quality. (Moore-IVI)
W84-03127

PRODUCTION AND DISTRIBUTION OF BENTHIC MICROALGAE IN THE LITTORAL SEDIMENTS OF MIKOLAJSKIE LAKE,
Rostock Univ. (German D.R.).
N. Wasmund, and A. Kowalczewski.
Ekologia Polska, Vol. 30, No. 3-4, p 287-301, 1982. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Littoral environment, *Algae, Benthic environment, Primary productivity, Lakes, Littoral zone, Mikolajskie Lake, Sediments.

Lake littoral is a specific environment characterized, among other things, by a great accumulation of algal biomass. For Mikolajskie Lake both chlorophyll and biomass in the top layers of sediments is related with the degree of site exposition to wave action, suggesting an easy transport of algae by waves to other sites of the littoral, or/and within the sediments. Vertical movements of benthic microalgae were noticed during the day. Photosynthetic activity of these algae was lower than that of other algal communities. Sampling techniques allowed the separation of sediment layers 1 cm thick down to the depth of 10 cm. Production was estimated in place for practically undisturbed samples. There is a distinguished vertical differentiation of the amount of chlorophyll and biomass, especially at a site protected against the wave action. Diurnal vertical migrations of benthic microalgae were visible. The quick diminution of light within sediments limited the production of these algae to the upper few millimeters of sediments. Production of benthic microalgae seems to be better related with the amount of chlorophyll than with biomass determined from cell volumes. Benthic microalgae may be the most important algal producer in shallow littoral communities. (Murphy-IVI)
W84-03133

THERMAL CONDITIONS OF BOTTOM SEDIMENTS IN FIVE SHALLOW LAKES OF MASURIAN LAKELAND,
Panstwowy Inst. Hydrologiczno-Meteorologiczny, Mikolajki (Poland). Regional Observatory.
S. Tyczynska.
Ekologia Polska, Vol. 30, No. 3-4, p 303-325, 1982. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Thermal stratification, *Bottom sediments, *Shallow lakes, *Masurian Lakeland, Heat budget, Lake sediments, Thermal properties, Temperature gradient, Sediment-water interfaces, Poland.

Thermal conditions of bottom sediments to the depth of 4 m distinguish four thermal periods in a year. They are characterized by normal (June-August), reverse (December-March), spring and autumn (no homothermy). In the summer the epilimnion is the water and the thermocline and hypolimnion is in the sediments for all thermal zones in deep lakes. In the winter temperatures under the ice in the top layers of sediments increases in the shallowest lake (mean depth 0.6 m), whereas in other lakes the temperature decreases. The heat budget of sediments to total heat budget of the lake is reversely proportional to the depth of the lake and according to meteorological conditions is 28-42% in Gardynskie Lake (mean depth 2.4 m) and 56-70% in Lake Luknajno (mean depth 0.6 m). (Murphy-IVI)
W84-03134

DISTRIBUTION OF FISH AND FOOD OF ROACH RUTILUS RUTILUS, BLEAK ALBURNUS ALBURNUS BREAM ABRUMIS BRAMA AND RUFFE ACERINA CERNUA IN LAKE VANSJO, SOUTH-EAST NORWAY (FORDELING AV FISK, SAMT ERNAERING HOS MORT, LAUE, BRASME OG HORK I VANSJO, OSTFOLD),
Oslo Univ. (Norway). Lab. for Freshwater Ecology and Inland Fisheries.
A. Brabrand.
Fauna, Vol. 36, No. 2, p 57-64, 1983. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Roach, *Bleak, *Bream, *Ruffe, *Fish food, *Lake Vansjo, *Norway, Fish diet, Fish behavior, Food habits, Aquatic habitats, Distribution patterns, Fish populations.

Fish fauna distribution in different parts of the meso-/eutrophic lake Vansjo, SE Norway were dominated by roach, bleak, bream, white bream, perch and ruffe in the shallow parts of the lake, while roach and bleak were also pelagically at night, in the upper water masses. In the littoral, roach had a variable diet including cladocerans, insect larvae and vegetation, while cladocerans were by far the most dominating food item for bleak. Pelagically both fed on cladocerans. Bleak size selected Bosmina and Daphnia. Bream and ruffe were both bottom feeders. Ruffe selected much more for animal food compared to the bream, which had a high proportion of sediments in their guts. (Murphy-IVI)
W84-03138

THE ECOLOGY OF LAKE NAKURU (KENYA); IV. BIOMASS AND DISTRIBUTION OF CONSUMER ORGANISMS,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
E. Vareschi, and A. Vareschi.
Oecologia, Vol. 60, No. 1, p 70-82, 1984. 13 Fig, 6 Tab, 50 Ref. German Science Foundation grants Ja 145/5 and 145/7.

Descriptors: *Ecology, *Lake Nakuru, *Kenya, *Biomass, Aquatic productivity, Consumer organisms, Saline lakes, Alkaline water, Ecosystems, Ecological distribution.

Consumer biomass and spatial distribution data provide the basis for estimating feeding and production rates, and for quantifying energy flow at the consumer level for the equitorial alkaline-saline Lake Nakuru. An outstanding characteristic of the lake is its biological simplicity. In order to estimate temporal biomass changes of all lake organisms, samples were taken at 19 stations at monthly intervals. The biomass of the only planktonic crustacean, the copepod Lovenuia africana was very high (1.5 g dry weight/cu m) in 1972 and 1973. Lovenula was absent in 1974 and 1975, and at very low levels in part of 1976. For short periods rotifers can be the dominant species of Lake Nakuru. During high salinity periods (greater than 20%) Hexarthra jenkinae occurred in very low numbers. Aquatic heteroptera (four species) contributed 0.4% to total consumer biomass in 1972 and 1973. In 1974-1976 the lake had no aquatic heteroptera. Benthic biomass (0.4 g dry weight/sq m) consisted almost exclusively of Leptochironomus deribae. For birds, Pelecanus onocrotalus accounts for approximately 90% of the biomass with peak densities of almost 20,000 birds. (Murphy-IVI)
W84-03149

THE ECOLOGY OF LAKE NAKURU (KENYA); V. PRODUCTION AND CONSUMPTION OF CONSUMER ORGANISMS,
Munich Univ. (Germany, F.R.). Zoologisches Inst.
E. Vareschi, and J. Jacobs.
Oecologia, Vol. 61, No. 1, p 83-98, 1984. 7 Fig, 13 Tab, 77 Ref. German Science Foundation grants Ja 145/5 and Ja 145/7.

Descriptors: *Lake Nakuru, *Kenya, *Production, *Consumption, *Consumer organisms, Energy balance, Rotifers, Copepods, Chironomids, Fish, Birds, Biomass, Water fowl.

Production and consumption rates were estimated from the distribution of numbers and size classes in the lake and laboratory experiments on growth and filtration rates. Data from consumer production and consumption in Lake Nakuru from 1972 to 1976, provide the basis for estimating the major pathways of energy flow. Rotifers (Brachionus dimidiatus and B. plicatilis), not especially significant in biomass, had the highest production rates. Consumption rates were correspondingly high. Copepods almost matched rotifers in 1972/73 but vanished from the lake in the following years. Chironomid larvae and fish had similar ranges of production and consumption. The fish had about twice the biomass of the insects. Most primary consumer organisms fed on the dominant primary producer, the cyanophyte Spirulina platensis, but rotifers and Leptochironomus met an unknown fraction of their energy requirements by consuming bacteria and detritus. The total fish yield taken by birds was 2,700-9,500 metric tons (wet weight) per year. (Murphy-IVI)
W84-03150

A QUANTITATIVE STUDY OF PHYTOPLANKTON OF THE RIVER GANGES AT BHAGALPUR, INDIA,
Bhagalpur Univ. (India). Post-Graduate Dept. of Botany and Zoology.
N. K. Singh, J. S. D. Munshi, and K. S. Bilgrami.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 2, p 81-87, 1983. 1 Fig, 2 Tab, 32 Ref.

Descriptors: *Phytoplankton, *Ganges River, *Bhagalpur, *India, Phosphorus, Nitrogen, Silicates, Chlorides, Temperature effects, Thermal stress, Benthos, Biomass.

Samples of Ganges River surface water were collected at monthly intervals from January, 1978 to December, 1978 using a water sampler. The maximum phytoplankton standing stock was in the summer with the highest peak in May when the water temperature was between 26 to 35 C. There was a sharp fall in standing stock when turbidity was very high. Free carbon dioxide was absent during active growth of phytoplankton (January to May) due to its utilization in photosynthesis. The pH rose during this period. The silicate level was considerably reduced when the standing stock of diatoms was maximum. Phosphorus and total nitrogen of water expressed inverse correlation to phytoplankton standing crop. Phosphorus, silicate and total nitrogen levels were higher during the rains while the chloride concentration rose during the summer. (Murphy-IVI)
W84-03151

ECOLOGY OF PLANKTONIC LARVAE OF DREISSENA POLYMORPHA (PALL.) IN LAKES WITH DIFFERENT DEGREE OF HEATING,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5C.
W84-03152

MIXING PROCESSES IN LAKES: MECHANISMS AND ECOLOGICAL RELEVANCE,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
D. M. Imboden, U. Lemmin, T. Joller, and M. Schurter.
Schweierische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 11-44, October, 1983. 21 Fig, 4 Tab, 38 Ref.

Descriptors: *Mixing, *Hypolimnion, *Lake Baldegg, *Switzerland, Tracers, Radon, Tritium, Helium radioisotopes, Water circulation, Kinetic energy, Wind, Heat exchange, Stratification, Internal waves, Energy transfer, Density gradients.

In Lake Baldegg, Switzerland (surface area 5.3 sq km, maximum depth 66 m) the analysis of data from moored instrument systems (atmospheric boundary layer, lake temperature distribution, bottom currents) was correlated to the long-term development of vertical mixing as seen from profiles of natural isotopes (radon-222, tritium and helium-3) and chemical species. Since the input of

kinetic energy by inlets is small, mixing in the lake is mainly driven by wind and heat exchange at the surface. During most of the year, thermally and chemically induced density stratification prevents the energy input from penetrating into greater depths. Part of the energy is trapped in internal waves running along the thermocline with little damping. Mixing in the surface layer is highly transient in nature. Strong temperature gradients develop in the surface layer on warm, calm days. Internal waves dominate the internal dynamics during stratification. Internal waves seem to be an important mechanism for kinetic energy transfer to the hypolimnion. The coherence between internal seiching and periodicities in the bottom currents supports this point. The indirect nature of energy transfer makes hypolimnion mixing less sensitive to meteorological forcing as long as stratification is well-developed and winds are not too strong. When vertical density gradients become weak, direct coupling between wind forces and mixing at all depths is observed. Internal loading is very significant in Lake Baldegg. Water ages, traced by helium and tritium, question the idea that as far as vertical mixing goes, stagnation and circulation are two well-distinguishable states of the lake. Renewal of deep hypolimnic water is significant even during stratification. (Moore-IVI)
W84-03167

CHEMICAL AND GEOCHEMICAL STUDIES OF LAKE BIEL; II. A CHEMICAL APPROACH TO LAKE MIXING,
Bern Univ. (Switzerland). Dept. of Inorganic Chemistry.
U. P. Uyffeler, P. W. Schindler, U. E. Wirz, and D. M. Imboden.
Schweizerische Zeitschrift fur Hydriologie, Vol. 45, No. 1, p 45-61, October, 1983. 12 Fig, 2 Tab, 24 Ref.

Descriptors: *Lake Biel, *Switzerland, *Mixing, *Eddy diffusion, Water temperature, Radon, Tracers, Water circulation, Chemical properties.

The mixing parameters in Lake Biel (Switzerland) are established in terms of coefficients of eddy diffusion in a two-dimensional box model. The vertical eddy diffusion coefficients were determined as a function of depth and time using the temperature method. Simultaneously with the temperature, the vertical excess Rn-222 concentration (*Rn-222) was measured. For observed transient Rn-222 distribution, transport by advection was included in the model calculations. A reasonable modelling of photosynthesis requires vertical subdivision of the epilimnion. Simultaneous measurements along one profile of two tracers that differ in the directions of their propagation give access to both vertical and horizontal lake mixing. The special suitability of Rn-222 is based on its short half-life time that produced high concentration gradients and permited recording short time phenomena. This method is restricted to comparatively small basins and to lake systems with Ra-226 bearing sediments. The eddy diffusion coefficients give an appropriate description of the observed distribution of both temperature and *Rn-222, but have limited physical significance as they are operationally defined in terms of an arbitary model. (Murphy-IVI)
W84-03168

HYDRODYNAMICS OF THE LAKE OF GENEVA,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
W. H. Graf.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 62-100, October, 1983. 28 Fig, 3 Tab, 21 Ref.

Descriptors: *Hydrodynamics, *Lake Geneva, *Lake Leman, *Switzerland, Orography, Hydrologic models, Model studies, Wind waves, Water circulation, Mathematical models, Air-water interfaces, Wind-driven currents, Mixing, Seiches, Storm surges.

In a certain sense, Lake Leman is an artifical lake since it is regulated hydraulically at Geneva (Switzerland). Extensive meteorological information, coupled with atmospheric dynamics over the lake helped develop working mathematical models. Air stability plays an important role for weak winds. Medium and strong winds are near neutral. Wind driven movement and wind generated surface waves are the types of lake motion which contributes to the movement (and mixing) in lake Leman and as to what types of wave climates exist. The movement in lakes is mathematically represented with a set of equations, namely the equations of continuity, of momentum, of heat conduction, of diffusion of matter and of state. For an incompressible, homogeneous and shallow lake, where the horizontal mixing is negligible compared with vertical mixing, the linearized system of equations are integrated. The steady-state circulation model and the storm surge and seiche models also use integrated mathematical models. (Murphy-IVI)
W84-03169

HYDRODYNAMIC STUDIES OF LAKE ZURICH AND LAKE LUGANO; A COMPARISON BETWEEN FIELD MEASUREMENTS AND RESULTS OF THEORETICAL MODELS, (STROMUNGSDYNAMISCHE UNTERSUCHUNGEN IM ZURICH- UND IM LUGANER-SEE; EIN VERGLEICH VON FELDMESSUNGEN MIT RESULTATEN THEORETISCHER MODELLE),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
K. Hutter.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 101-144, October, 1983. 26 Fig, 3 Tab, 81 Ref.

Descriptors: *Hydrodynamics, *Lake Zurich, *Lake Lugano, *Switzerland, *Mathematical models, *Water currents, Wind-driven currents, Hypolimnion, Isotherms, Seiches, Model studies, Density, Water temperature.

Density distribution and temperature and current data measured in Lake Zurich and Lake Lugano during two summer field programs are interpreted by means of hydrodynamic models. With the exception of the hypolimnion current the employed set of instruments was suitable to reliably measure the 'lake relevant' physical quantities. Comparisons of the time series of the isotherm depths permits correlation of the observed wind induced oscillations with the internal seiches behavior. Time series of limnigraphs mounted along the shores permit identification of the periodic barotropic components of the motion. By applying the shallow water equations to Lake Zurich, the periods and the structures of (even high) surface seiches are reliably predicted. For satisfactory prediction of wind-induced barotropic motions of Lake Zurich a three-dimensional circulation model is used. The nonlinear advective terms must be included in this analysis. Internal seiches are treated with a linear two-layer model, and periods and structures of the eigenmodes are well predicted with it. Baroclinic wind-induced motions are modelled by a three-dimensional FD-Model which is tested using a real, measured wind field. The motion, which is directly influenced by the wind is reliably predicted. The oscillations in the numerical model after the wind cessation are too attenuated. (Murphy-IVI)
W84-03170

NUMERICAL MODELS FOR THE CURRENTS SIMULATION OF A LAKE (MATHEMATISCHE MODELLE ZUR SIMULATION VON ZIRKULATIONSSTROMUNGEN IN EINEM SEE),
Laboratorio di Fisica Terrestre, Lugano-Trevano (Switzerland).
D. Bozzolo, R. Pamini, G. Salvade, F. Solca, and C. Spinedi.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 145-175, 1983. 30 Fig, 13 Ref.

Descriptors: *Mathematical models, *Computer models, *Lakes, *Water currents, Simulation, Wind-driven currents, Thermodynamics, Mixing, Thermal pollution, Water circulation, Lake Lugano.

The three-dimensional, finite-difference model o the physical processes in a lake has been adapted t the simulation of wind-induced currents and ther mal processes in the northern basin of Lak Lugano. The advantages of the model are the us of complete hydrodynamic and thermodynami equations, with only the Boussinesq approximatio and the modelling of eddy viscosity through dynamic algorithm. The model can simulate wind induced currents in a stratified lake, including a thermal interactions and inflows. Because of th size of the computer program, the model take long computation times in a large core compute The model includes all thermal interactions wit the atmosphere, wind-induced mixing processes inflows and outflows. The model predictions ar compared with data collected in 1979. A furthe application of the model is the cold inflow simula tion in a stratified basin with inclusion of turbuler vertical exchange processes. A two-dimensiona version of the model, which assumes an hydrosta ic presssure distribution, is utilized to simulate th thermal summer development of Lake Lugano during 40 days. The model includes the therma interactions and wind influence. The three-dimen sional model can be applied to current simulatio in lake basins. The two-dimensional model may b utilized to predict the development of a basi subject to a thermal load. (Moore-IVI)
W84-03171

UPTAKE, TRANSLOCATION AND RELEAS OF CARBON BY SUBMERSED MACRO PHYTES FROM RUNNING WATER HAB TATS (AUFNAHME, TRANSPORT UN ABGABE VON KOHLENSTOFF DURCH SUB MERSE MAKROPHYTEN VON FLIESSWAS SERSTANDORTEN,
Bayerisches Landesamt fuer Wasserwirtschaf Munich (Germany, F.R.).
V. C. Steinberg, and A. Melzer.
Schweizerische Zeitschrift fur Hydrologie, Vo 45, No. 1, p 333-343, October, 1983. 3 Fig, 21 Re

Descriptors: *Submerged plants, *Running water *Carbon, Hardness, Plant metabolism, Roots, Fol age, Uptake, Translocation.

Uptake, translocation and release of inorgani carbon were tested in partitioned chambers wit submersed running water macrophytes from har water habitats (Potamogeton coloratus, Ranunc lus fluitans, R. circinatus, Myriophyllum spicatu Callitriche obtusangula and Berula erecta) and fluitans from a soft-water habitat. All species we able to remove labelled inorganic carbon from th water by both systems, foliage and rhizome/ro system, the uptake via foliage predominating clea ly. Most of the carbon taken up by the rhizome root system was translocated into the phytosynth tically active tissues, most likely as an inorgani species of carbon dioxide. The reversed transloc tion was rather small with most of the specie probably due to short exposure times. Release labelled carbon was below 1% of total uptak except for C. obtusangula and R. fluitans from th soft-water habitat. The low carbon release is reasonable adaptation to the constantly renewi milieu in running-water habitats. (Moore-IVI)
W84-03175

OXYGEN REGIME IN A FISHPOND WIT DUCKWEEDS (LEMNACEAE) AND CERAT PHYLLUM,
Ceskoslovenska Akademie Ved, Trebon. Dept. Hydrobotany.
J. Pokorny, and E. Rejmankova.
Aquatic Botany, Vol. 17, No. 2, p 125-137, Oct ber, 1983. 3 Fig, 4 Tab, 21 Ref.

Descriptors: *Duckweed, *Ponds, *Oxygen ba ance, Fish, Phytoplankton, Vegetation, Lemn ceae, Ceratophyllum, Nutrients,.

In small fishponds, usually highly eutrophic, co munities of Ceratophylletum demersi with a cov of duckweeds occurs. Through their relative high biomass this vegetation influences the g regime in the fishponds. The depth of oxygen a the daily changes in oxygen concentration we

assessed by in situ measurements in stands of Lemnaceae, Ceratophyllum, Lemnaceae plus Ceratophyllum, and phytoplankton at the peak of the vegetation season. With the aim of excluding the influence of phytoplankton on the diurnal oxygen course, oxygen concentrations were measured in near natural conditions below both the dense and the loose covers of Lemnaceae, placed in nutrient solution. The duckweeds Lemna minor and Spirodela polyrhiza did not release any oxygen into the water on which they were floating. The frequently occurring combination of submerged Ceratophyllum with floating ducksweeds improves the oxygen concentration in the fishpond water as compared with water covered only by duckweeds. Oxygen is transported from the upper aerated water layers to the bottom of the shallow pond. The average oxygen concentration was up to 2 mg/liter lower when sediments were present, and the flow of oxygen to the bottom amounted to 4 g/sq m/day. (Baker-IVI)
W84-03195

IMPACT OF ACIDIFICATION AND EUTROPHICATION ON MACROPHYTE COMMUNITIES IN SOFT WATERS IN THE NETHERLANDS. I. FIELD OBSERVATIONS,
Katholieke Univ., Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. G. M. Roelofs.
Aquatic Botany, Vol. 17, No. 2, p 139-155, October, 1983. 1 Fig, 6 Tab, 41 Ref.

Descriptors: *Eutrophication, *Acidification, Macrophytes, Netherlands, Littoral environment, Aquatic life, Light intensity.

Aquatic habitats appear to be very susceptible to the effects of acidification. The mechanisms of acidification, however, appear to be very complex and are not yet clearly understood. A strong decline has been noticed in the number of waters dominated by Littorellion species during the last decades. These have been mainly isoetids such as Lobelia dortmanna L., Isoetes lacustris L., and Littorella uniflora (L.) Aschers. Investigations were carried out at 68 locations where the waters were known to be dominated by L. uniflora after 1950. In 1980, L. uniflora appeared to be absent or to have strongly decreased in 53 (78%) of these waters. In 41 of them, Littorella had been replaced by submerged Juncus bulbosus L. and/or Sphagnum spp. Changed inorganic carbon budgets appear to be responsible for the changes resulting as an effect of acidification. Eutrophication of the water and/or sediment in the remaining 12 water sources seems to be responsible for the changes in the plant communities. Enrichment with phosphate of the mineral sediment alone led to luxurious growth of submerged, rooted macrophyte species such as Myriophyllum alterniflorus DC and Ranunculus peltatus Schrank. Phosphate-enrichment of both sediment and water led to luxurious growth of pleustophytes such as Riccia fluitans L. and Lemna minor L. in small, shallow waters and to plankton bloom and growth of epiphytes in larger, deeper waters. Light limitations seem responsible for the disappearance or decline of the Littorellion species. (Baker-IVI)
W84-03196

CARBONATE MINERALOGY OF LAKE SEDIMENTS AND SURROUNDING SOILS. 2. THE QU'APELLE LAKES,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
K. Ghebre-Egziabhier, and R. J. St. Arnaud.
Canadian Journal of Soil Science, Vol. 63, No. 2, p 259-269, May, 1983. 5 Fig, 3 Tab, 13 Ref. NSERC Grant No. A1446.

Descriptors: *Lake sediments, *Carbonates, Mineralogy, Lakes, Sediments, Qu'Appelle Lake, Magnesium, Dolomite, Erosion.

The nature and distribution of carbonate minerals in the upper Qu'Appelle basin in south-central Saskatchewan were investigated. Erosional effects appear to have resulted in sediments which were derived largely from neighboring landscapes. Of particular importance is the build-up of carbonates in these sediments in situations where the water chemistry of the lake waters favors precipitation of calcium carbonate. Waters in the Fishing Lakes (Pasqua, Echo, Katepwa) contain appreciably more soluble salts than Buffalo Pound Lake upstream from them. The increased $CaCO_3$ contents of the sediments in going from the Buffalo Pound to the Pasqua, and Echo Lakes coincide with the increased ionic concentrations of calcium and carbonate ions, as reflected by increasing ionic activity products. This parallelism plus the presence of Mg-bearing calcites supports the evidence indicating that carbonates are being precipitated in the lakes. (Baker-IVI)
W84-03224

THE MACROINVERTEBRATE FAUNA OF THE DRAINAGE CHANNELS OF THE GWENT LEVELS, SOUTH WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W84-03289

THE IMPACT OF ZOOPLANKTON FEEDING ON THE EPILIMNETIC BACTERIA OF A EUTROPHIC LAKE,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
C. Pedros-Alio, and T. D. Brock.
Freshwater Biology, Vol. 13, No. 3, p 227-239, June, 1983. 4 Fig, 4 Tab, 43 Ref. NSF grant DEB-8212459.

Descriptors: *Zooplakton, *Feeding rates, *Epilimnion, *Bacteria, *Eutrophic lakes, Ecological effects, Biomass, Lake Mendota, Population dynamics.

In order to elucidate the importance of zooplankton feeding on bacteria in Lake Mendota, biomass and production of heterotrophic bacteria have been measured over a 2 year period and while the biomass was fairly constant from year to year, production was very high from June to October. Feeding of zooplankton on bacteria was measured by a cell counts method in 1979 and using radioactively labelled natural assembleges of bacteria in 1980. Total feeding was calculated and was found to account for 1-60% of the bacterial heterotrophic production. Annually, it accounted for 1-10% of the bacterial heterotrophic production. Since bacterial biomass does not change significantly from year to year and yet bacterial production is very high compared to feeding by zooplankton, mechanisms other than feeding must exist which remove biomass from the epilimnetic bacteria in larger amounts. (Murphy-IVI)
W84-03290

THE EFFECTS OF SURFACE GEOLOGY AND STREAM SIZE ON FRESHWATER MUSSEL (BIVALVIA, UNIONIDAE) DISTRIBUTION IN SOUTHEASTERN MICHIGAN, U.S.A.,
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
D. Strayer.
Freshwater Biology, Vol. 13, No. 3, p 253-264, June, 1983. 8 Fig, 2 Tab, 42 Ref.

Descriptors: *Mussels, *Habitats, Michigan, Mollusks, Turbidity, Streams, Catchment areas, Aquatic habitats.

Stream size and surface geology are the two major environmental features controlling the distribution of the 34 species of unionid mussels living in streams in southeastern Michigan. Surface geology, a previously unrecognized factor in the ecology of freshwater mussels, regulates the hydrology, slope and turbidity of streams in this area. Reciprocal averaging ordinations are used to aid the description of the habitats occupied by each mussel species. Thus the theory that the catchment of a stream is partially responsible for the biota of that stream has been verified. In general, conditions at any site along a stream are defined both by constraints that are imposed on all running waters such as hydraulic geometry and by the catchment of that particular stream. (Baker-IVI)
W84-03291

THE PHYSICAL LIMNOLOGY OF AUGHER LOUGH (NORTHERN IRELAND),
New Univ. of Ulster, Coleraine (Northern Ireland). Limnology Lab.
B. Ripley.
Freshwater Biology, Vol. 13, No. 4, p 353-362, August, 1983. 7 Fig, 3 Tab, 33 Ref.

Descriptors: *Limnology, *Augher Lough, *Ireland, Thermal stratification, Hypolimnion, Oxygen deficit, Thermocline, Epilimnion, Hypolimnion, Eddy diffusion, Heat budget.

The physical limnology of Augher Lough, Northern Ireland (area = 9.25 ha, mean depth = 5.5 m), including stratification pattern, heat budget, thermocline erosion rate, eddy diffusion rate in the thermocline and hypolimnion and areal hypolimnetic oxygen deficit provides a suitable background for an examination of the recent sedimentary record. The aim is to present a description of the physical limnology of Augher Lough and to compare this with the behavior expected from the relationships of physical limnology. Oxygen and temperature profiles, at two sites during 1978 and four sites during 1979, showed that spatial variability of these quantities was low and allowed the following lake characteristics to be estimated. Heat budget was 5.30 kcal/sq cm (standard deviation = s = 0.26) in 1978 and 5.00 (s = 0.26) in 1979. The thermocline depth was 3.5-6.5 m with an erosion rate of 1.9 x .000001 m/s in 1979. Eddy diffusion coefficients of heat in the thermocline and hypolimnion normally ranged from 0.48 x 0.1 sq cm/s (s = 0.20 x 0.1) to 5.4 x 0.1 (s = 2.6 x 0.1), but reached 10 x 0.1 sq cm/s (s = 9 x 0.1) in early July 1978 after a cooling-mixing episode in the epilimnion. The hypolimnetic oxygen deficit was 680 mg O_2/sq m/d (s = 76) and varied strongly with depth. A cooling-mixing episode in the epilimnion in June-July 1978 caused the movement of heat down to 8 m, movement of oxygen down to 6 m and increased the eddy diffusion coefficients of heat by an order of magnitude. (Murphy-IVI)
W84-03294

MICROBIAL HETEROTROPHIC UTILIZATION OF DISSOLVED ORGANIC MATTER IN A PIEDMONT STREAM,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 5B.
W84-03295

BIOMASS AND PRODUCTION OF PHYTO- AND BACTERIO-PLANKTON IN EUTROPHIC LAKE TYSTRUP, DENMARK,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
B. Riemann.
Freshwater Biology, Vol. 13, No. 4, p 389-398, August, 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Biomass, *Phytoplankton, *Bacterioplankton, *Eutrophic lakes, *Lake Tystrup, *Denmark, Primary productivity, Organic matter, Bacteria.

The phytoplankton in eutrophic lakes plays a dominant role in the production of organic matter. Decomposition and mineralization of the organic matter are mainly bacterial processes. Phytoplankton primary production and biomass were compared with bacterial secondary production estimated by means of frequency of dividing cells (FDC) in eutrophic Lake Tystrup, Denmark. In the upper part of the photic zone, bacterial secondary production constituted 12% of the carbon fixed by the phytoplankton. In vertical profiles, bacterial secondary production ranged from 7.6% (early spring) to 121% (during August) of the carbon fixed by the algae. A close relationship was found between occurrence and activity of bacteria, and algae, suggesting that released organic products are of primary importance to the bacteria. The annual phytoplankton primary production was estimated as 227 g C/sq m compared to 102 g C/sq m assimilated by the bacteria, so 45% of the carbon

fixed by the photoplankton went through pelagic bacteria. (Murphy-IVI)
W84-03296

PRIMARY PRODUCTIVITY STUDIES DURING EARLY YEARS OF WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 5C.
W84-03299

COMMUNITY STRUCTURE IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMICAL FACTORS,
University of East Anglia, Norwich (England). School of Biological Sciences.
For primary bibliographic entry see Field 5C.
W84-03300

THE COLONIZATION OF BALL-CLAY PONDS BY MACROINVERTEBRATES AND MACROPHYTES,
Exeter Univ. (England). Inst. of Biometry and Community Medicine.
L. E. Barnes.
Freshwater Biology, Vol. 13, No. 6, p 561-578, December, 1983. 8 Fig, 3 Tab, 37 Ref.

Descriptors: *Community development, *Ponds, *Macroinvertebrates, *Macrophytes, Population dynamics, Population density, Hydrogen ion concentration, Principal component analysis.

To provide information of practical application in the management of new ball-clay ponds in the present study, it was necessary to investigate colonization over a much longer time-span and to include both macrophytes and macroinvertebrates. The rate and nature of colonization of ball-clay ponds by aquatic macrophytes and macroinvertebrates were studied by comparing communities present in a series of ten ponds of similar dimensions, but of different ages, ranging from 6 months to 15 years. Multivariate analyses of the biotic data distinguished between 'neutral' and 'acid' ponds; further analyses concentrated on the former type. Initial colonization of neutral ponds was rapid with a predictable sequence of species arrival, probably reflecting short dispersal distances. Variations in macroinvertebrate invasion times were related to dispersal strategy and ability. As the pond aged, successional changes, linked with macrophyte colonization, produced a shift in dominance from algivores and predators towards epiphyton grazers and detritivores. Some evidence of succession of species within invertebrate orders was found. Low pH affected colonization principally by preventing the establishment of acid-intolerant immigrant species, but also by retarding succession. It is concluded that non-interactive models of insular colonization, with constant immigration and extinction rates, are of limited applicability to pond colonization in temperate areas. (Murphy-IVI)
W84-03301

DIATOMS IN FOUNTAINS, RESERVOIRS AND SOME OTHER HUMID AND DRY LOCALITIES IN ROME, ITALY,
N. Foged.
Nova Hedwigia, Vol. 38, p 433-455, 1983. 1 Tab, 35 Ref.

Descriptors: *Diatoms, *Fountains, *Reservoirs, *Rome, *Italy, Hydrogen ion concentration.

Fountains, reservoirs, waste-pipes and other more or less moist localities in towns are often biotopes with a character of their own and generally fairly rich. The analyzed content from 21 samples collected in 1951 from 17 localities in Rome, Italy (fountains, reservoirs and other humid and dry localities), revealed 135 taxa of diatoms from 31 genera. The water, which in 1951 chiefly came from the surrounding country through aqueducts, was more or less alkaline. (Murphy-IVI)
W84-03311

LIFE HISTORY AND ECOLOGY OF THE HUMPBACK CHUB IN THE LITTLE COLORADO AND COLORADO RIVERS OF THE GRAND CANYON,
Fish and Wildlife Service, Flagstaff, AR. Colorado River Fishery Project.
L. R. Kaeding, and M. A. Zimmerman.
Transactions of the American Fisheries Society, Vol. 112, No. 5, p 577-594, September, 1983. 11 Fig, 5 Tab, 21 Ref.

Descriptors: *Fish, *Rivers, Colorado River, Little Colorado River, Grand Canyon, Seasonal variations, Littoral environment, Darkness, Light intensity, Habitats, Aquatic habitats, Fish behavior, Humpback chub.

The loss of habitat for some native fishes of the Colorado River drainage coincided with the closure of Flaming Gorge Dam on the Green River. Humpback chubs in the Little Colorado River grew rapidly to about 250-300 mm in length at 3 yr of age, the onset of reproductive maturity for the female. Annual reproductive success was greatest when spawning coincided with seasonal river runoff. Use of the physical habitat by age-0 and juvenile humpback chubs was affected by light intensity. Shallow littoral areas were used during darkness, but during daylight only when the water was turbid. Year-round low temperatures in the Colorado River did not inhibit seasonal gonadal maturation of humpback chubs. However, lab studies indicate that such low temperatures result in nearly complete mortality of embryonic and larval humpback chubs. Persistence of the fish in the Little Colorado River could be attributable, in part, to the unsuitablility of that environment, and that of the Colorado River, for potential competitor or predator species in the drainage. (Baker-IVI)
W84-03313

MORTALITY OF WALLEYE EGGS AND RAINBOW TROUT YOLK-SAC LARVAE IN LOW-PH WATERS OF THE LACLOCHE MOUNTAIN AREA, ONTARIO,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
P. F. Hulsman, P. M. Powles, and J. M. Gunn.
Transactions of the American Fisheries Society, Vol. 112, No. 5, p 680-688, September, 1983. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Mortality, *Walleye, *Trout, *Larvae, *Acid waters, *LaCloche mountains, *Ontario, Streams, George Lake, Hydrogen ion concentration, Acidity, Acidic water, Toxicity.

Freshly fertilized eggs of walleye Stizostedion vitreum were incubated in the outlet waters of George Lake (pH 5.4) and sections of a nearby stream (pH 6.0, 6.6). Walleye egg mortality was low (25.5-33.5%) at pH 6.0. High mortality (90.5%) occurred between fertilization and the eyed-egg stage at the pH 5.4 site. Mortality of rainbow trout yolk-sac larvae approached 100% within 5 days at both pH 4.6 and 5.4. In contrast, total mortality was less than 3% at pH 6.0 and also in low-pH humic water (pH 5.5). The high mortality rate in the acidic outlet waters of George Lake suggests that the acidification of this lake was responsible for the extinction of its walleye stock. The striking differences in mortality of rainbow trout yolk-sac larvae between sites of similar pH (5.4-5.5) indicated that H(+) toxicity was not solely responsible for fish mortality in acid water. (Murphy-IVI)
W84-03316

REDD-SITE SELECTION BY BROOK TROUT AND BROWN TROUT IN SOUTHWESTERN ONTARIO STREAMS,
Guelph Univ. (Ontario). Dept. of Zoology.
L. D. Witzel, and H. R. MacCrimmon.
Transactions of the American Fisheries Society, Vol. 112, No. 6, p 760-771, November, 1983. 3 Fig, 6 Tab, 43 Ref. National Sciences and Engineering Research Council of Canada grant A1719.

Descriptors: *Fish behavior, *Streams, *Habitats, Canada, Ontario, Trout, Fish, Aquatic habitats. Redd-substrate composition, water velocity, depth, and other environmental variables associated with redd-site selection and spawning by brook trout and brown trout were examined in southwestern Ontario streams. Sympatric and allopatric populations spawned in similar ranges of specific conductance (225-810 micromhos/cm), pH (7.0-8.2), dissolved oxygen (greater than 83% saturation), and stream gradient (0.2-2.3%). Brook trout spawned only in areas of groundwater seepage, typically near headwaters where streamflow did not exceed 177 liters/second. Brown trout spawned in a wider range of flows and used locations both with and without groundwater seepage. Reuse of redds was mostly intraspecific. Mean water depth over redds selected by brook and brown trout were similar. However, mean stream velocities were significantly slower at brook trout (17.6 cm/second) than at brown trout reeds (46.7 cm/second). Redd-site preference by brook trout for the areas of groundwater seepage and by brown trout for faster water velocities and coarser substrates minimized species interactions during spawning. (Baker-IVI)
W84-03320

REPRODUCTION BY THE ENDANGERED CUI-UI IN THE LOWER TRUCKEE RIVER
Fish and Wildlife Service, Reno, NV.
G. G. Scoppettone, G. A. Wedemeyer, M. Coleman, and H. Bruge.
Transactions of the American Fisheries Society, Vol. 112, No. 6, p 788-793, November, 1983. 5 Fig, 11 Ref.

Descriptors: *Fish behavior, *Rivers, Cui-ui, Lower Truckee River, Reproduction, Fish, Aquatic habitats, Habitats, Reproducibility.

The cui-ui is an endangered species endemic to Pyramid Lake, Nevada, and is thought to be the sole surviving genetically pure member of its genus. Water-project developments dating back to the turn of the century have regulated Truckee River flows and diverted water for agricultural and municipal uses. As a result, the level of Pyramid Lake dropped approximately 25 m, and a large shallow delta formed at the mouth of the river. Adult spawning behavior and emigration of larvae of the endangered cui-ui Chasmistes cujus were studied in a natural side channel of the lower Truckee River. The river phase of cui-ui life appeared to be extremely brief. Most migratory and spawning activity occurred at night. The external radio-tags apparently did not affect spawning behavior. Adults spawned over predominantly gravel substrate under a broad range of water depths and velocities. Eggs were buried to about 10 cm in the substrate. Cui-ui larvae apparently emigrated downstream to Pyramid Lake immediately after swim-up. (Baker-IVI)
W84-03321

SULPHUR AND CHLORIDE DEPOSITION AND ECOSYSTEM TRANSPORT IN STRONGLY ACIDIFIED LAKE WATERSHED
Swedish Water and Air Pollution Research Lab. Goeteborg.
For primary bibliographic entry see Field 5B.
W84-03388

COMPARATIVE WATER CHEMISTRY OF FOUR LAKES IN ROCKY MOUNTAIN NATIONAL PARK,
National Park Service, Fort Collins, CO. Water Resources Field Support Lab.
J. Baron.
Water Resources Bulletin, Vol. 19, No. 6, p 895-901, December, 1983. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Water chemistry, *Mountain lakes, *Rocky Mountain National Park, Colorado, Chemical properties, Inorganic compounds, Biological filters, Weathering, Nitrates, Sulfates.

Lake chemistry is the product of its inputs, components of which include weathering of primary parent materials and soils, biological leachates, and precipitation. The inorganic chemistry of four hi

titude lakes which appear similar superficially as compared to determine what controls variation between them. Weathering from the different pes of parent material caused differing cation oncentrations between the lakes by dissimilar concentrations of those cations which are products of imary weathering. There was s significant difference in anion concentrations between members of ie pair having the same bedrock geology. This fference is attributed to the presence of a wet dge meadow above one of the lakes which serves a biological filter for anions, particularly nitrate d sulfate. Small scale drainage characteristics hich can alter regional atmospheric contributions e important contributors to lake chemistry. Murphy-IVI)
'84-03393

RANSPORT IN LAKE WATER QUALITY ODELING,
nvironmental Research and Technology, Inc., oncord, MA.
Shanahan, and D. R. F. Harleman.
ournal of Environmental Engineering, Vol. 110, o. 1, p 42-57, February, 1984. 3 Fig, 25 Ref. NSF ant CEE-7906125.

escriptors: *Lakes, *Water quality, *Model studs, Dispersion, Diffusion, Mathematical models, ydrodynamics, Finite difference models, Multie-box models.

n important aspect of lake water quality modelg is the transport due to diffusion and dispersion ocesses. The determination of dispersive transrt is examined relative to model spatial structure d numerical formulation. Two basic model types e identified: the finite difference model (a continm approach); and the multiple-box model (a screte approach). Analysis of these two apoaches indicates that the multiple-box model forulation introduces substantial implicit dispersion a consequence of its discrete structure. Due to is implicit dispersion, multiple-box model exange flow or dispersion parameters cannot be etermined directly based on the hydrodynamics the prototype lake - only calibration is a viable proach. Despite the conceptual advantages of nite difference models over box models, box odels will continue to be used as a simple and st-effective alternative for lake water quality odeling. Box models can serve as a reasonable proximation provided the implicit model disperon is properly considered in model formulation. uidelines are recommended for construction of ultiple-box lake water quality models. (Moore-VI)
'84-03469

ULTILEVEL WITHDRAWAL AND WATER UALITY,
cole Nationale des Ponts et Chaussees, Paris rance).
Gaillard.
ournal of Environmental Engineering, Vol. 110, o. 1, p 123-129, February, 1984. 6 Fig, 6 Ref.

escriptors: *Selective withdrawal, *Water qualy, *Mathematical models, Reservoir operation, eservoir releases, Outlets, Stratification, Granent Reservoir, France.

he efficiency of selective withdrawal depends on e type of reservoir, hydrologic conditions, flow water quality and water quality objectives. water quality simulation model appears to to be ne of the better tools for synthesizing all such ata for determining relationships between water uality, outlet locations and reservoir operation. A ne dimensional vertical model of water quality in eservoirs was developed, calibrated, and verified sing data for the years 1978 and 1979 from Granent reservoir in France. The model was used for ne study of the influence of outlet location on oth reservoir and outflow water quality. Three ifferent outlet locations were considered on the rangent reservoir, as well as various conditions inflow water quality, reservoir size and reservoir peration. The reservoir water quality model apears to be particularly efficient for the study of ne complex relations between outflow water quality, outlet location, and water quality stratification in the reservoir. (Moore-IVI)
W84-03472

STRATIFICATION AND MIXING IN LAKES OF TAYLOR COUNTY, WISCONSIN, WITH EMPHASIS ON RICHTER LAKE,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
K. M. Stewart, and W. A. Stewart.
Archiv fur Hydrobiologie, Vol. 98, No. 2, p 250-264, October, 1983. 6 Fig, 3 Tab, 29 Ref.

Descriptors: *Stratification, *Mixing, *Winterkill, *Richter Lake, *Wisconsin, Glacial kettle lakes, Dissolved oxygen, Ice cover.

A limnological investigation was carried out on eight lakes (Diamond, Eska, Kathryn, Nineteen, North Twin, Richter, Spruce, and Thirty-three) in the lower Chequamegan National Forest in Taylor County, Wisconsin. The glacial kettle lakes range in area from 2.6 to 25 ha and in depth from 9.1 to 19.2 m. Winterkill occurs in some of these lakes as an occasional or aperiodic event, whereas in others the phenomenon occurs annually with varying degrees of severity. Because most of the lakes are relatively deep with respect to surface area, an explanation for the poor to marginal oxygen conditions was sought. Richter Lake was selected for the most detailed studies. If its vernal and autumnal mixing are fairly representative, then problems of aperiodic winterkill in these small but relatively deep lakes are more easily understood. Richter has long periods of ice and snow cover, a strong winter and summer stratification, an incomplete vernal mixing, and only a brief period of complete autumnal mixing. The lake does not have time to achieve full oxygen saturation in either spring or autumn before the lake restratifies, thus perpetuating marginal conditions which are probably inadequate to handle the organic loading from this mostly forested region. The Secchi visibilities are generally low in these moderately stained waters. Lake Thirty-three has some meromictic characteristics. (Moore-IVI)
W84-03491

PRELIMINARY MEASUREMENTS OF PRIMARY PRODUCTION AND COMMUNITY RESPIRATION IN A FOREST STREAM IN HONG KONG,
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Archiv fur Hydrobiologie, Vol. 98, No. 3, p 287-298, November, 1983. 5 Fig, 29 Ref.

Descriptors: *Primary productivity, *Respiration, *Forest streams, *New Territories, *Hong Kong, Lotic environment, Energy, Dissolved oxygen, Pools, Riffles.

Comparative measurements of primary production (P) and community respiration (R) were undertaken in a shaded riffle reach and an unshaded pool in Tai Po Kau Forest Stream, New Territories, Hong Kong. It was hoped that such a study would enable an assessment of the relative importance of allochthonous and autochthonous carbon sources to the energy budget of the stream as a whole to be made. The procedure employed was the twin curve method involving measurements of dissolved oxygen concentrations at regular intervals over a 24-hour period. Such procedures have rarely been employed in studies of lotic habitats in Asia. Calculated P/R ratios varied between 1.02 in the shaded pool site and 0.17 in the shaded riffle reach. P values recorded in the pool site were considerably higher than those recorded in unpolluted streams in temperate regions. Despite this, it was apparent that the bulk of the energy requirements of the consumers in Tai Po Kau Forest Stream were met from allochthonous sources, such a characteristic probably typifying the metabolism of lotic habitats in forest watersheds. (Author's abstract)
W84-03492

RELATIONSHIPS AMONG CHEMICAL, PHYSICAL, AND BIOLOGICAL INDICES ALONG RIVER CONTINUA BASED ON MULTIVARIATE ANALYSES,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
C. E. Cushing, C. D. McIntire, K. W. Cummings, G. W. Minshall, and R. C. Petersen.
Archiv fur Hydrobiologie, Vol. 98, No. 3, p 317-326, November, 1983. 2 Fig, 3 Tab, 26 Ref. NSF grants BMS-75-07333 and DEB-7811671.

Descriptors: *Multivariate analysis, *River Continuum Concept, *Stream classification, Physical properties, Biological properties, Chemical properties, Respiration, Ecosystems, Precipitation, Stream gradient, Stream length, Watersheds.

A variety of multivariate analyses were applied to chemical, physical, and biological data from 16 stream sites to explore the usefulness of these factors in possible stream classification systems and to test hypotheses of the River Continuum Concept. High positive correlations were found between stream gradient and the ratio of shredder to collector organisms and between benthic respiration and high ratio of FBOM to CBOM; a high negative correlation was found between P/R ratio and high shredder to grazer ratio. These and other results support predictions of the River Continuum Concept. Ordination analyses of the untransformed biological data and of the total data base resulted in rankings of the variables suggestive of a gradation from those characteristics of low order (1-2) streams to those characteristics of higher orders (4-6). In general, the overall ordination rankings of the stream sites also were suggestive of a low to high order continuum. Correlation of ordination scores of the untransformed biological data with the different physical-chemical variables suggested that precipitation, gradient, and stream length to watershed area best explained the ordination rankings, and that the shredder to collector ratio, shredder to grazer ratio, UBOM to CBOM ratio, FBOM to CBOM ratio, and gross production were the most influential biological variables. Findings suggest that streams are best viewed as gradients, or continua, and that classification systems which separate discrete reaches are of little ecological value. (Author's abstract)
W84-03494

THE IMPORTANCE OF ATTACHMENT TO PARTICLES FOR PLANKTONIC BACTERIA,
Universidad Autonoma de Barcelona (Spain). Dept. de Microbiologia.
C. Pedros-Alio, and T. D. Brock.
Archiv fur Hydrobiologie, Vol. 98, No. 3, p 354-379, November, 1983. 5 Fig, 6 Tab, 93 Ref.

Descriptors: *Plankton, *Bacteria, *Particles, *Bacterioplankton, Epilimnion, Biomass, Sedimentation, Hydraulic flushing, Zooplankton, Lake Mendota, Wisconsin.

The importance of attachment to particles for heterotrophic bacteria in the epilimnion of Lake Mendota, Wisconsin, was analyzed. Attached bacteria constituted from 1% (in winter) to 30% (in summer) of the total cell counts obtained by epifluorescence. When biomass was calculated from counts and volumes measured in scanning electron micrographs, attached bacteria contributed up to 50% of the total biomass. Three indicators of bacterial activity were measured separately for attached and freeliving bacteria: frequency of dividing cells (FDC), dark sulfate uptake, and acetate uptake. Attached bacteria were bigger, had higher FDC, and were responsible for most of the acetate uptake. Free-living bacteria were smaller with lower FDC, and responsible for most of the sulfate uptake. Using this information and results from other studies, hydraulic flushing of the system, abundance of particles, sedimentation, and feeding by zooplankton were considered to be the most important factors in regulating what percent of the bacterioplankton activities and biomass is due to attached bacteria in a given system. (Author's abstract)
W84-03495

CALCITE PRECIPITATION AS A NATURAL CONTROL MECHANISM OF EUTROPHICATION,
Zentralinstitut fur Mikrobiologie und Experimentelle Therapie der Akademie der Wissenschaften der DDR, Jena. Abt. Limnologie.
R. Koschel, J. Benndorf, G. Proft, and F. Recknagel.
Archiv fur Hydrobiologie, Vol. 98, No. 3, p 380-408, November, 1983. 15 Fig, 5 Tab, 58 Ref.

Descriptors: *Calcite precipitation, *Eutrophication, *Lake Breiter Lucin, *East Germany, Phosphorus, Phytoplankton, Light transmission, Algae, Flocculation, Model studies.

The observations of calcite precipitation in the deep mesotrophic Lake Breiter Lucin (Germany, D.R.) indicated that calcite precipitation is connected with a decrease in dissolved and total phosphorus, phytoplankton biomass and light transmission. Additional investigations in other lakes of the same geographical region show that the maximum of calcite in the sinking material is found 2 to 4 weeks after the maximum of primary production of phytoplankton. The calcite content of the profundal sediments exhibits high values in eutrophic especially in mesotrophic lakes and small values in oligotrophic lakes. All the observations show that calcite precipitation must be linked with a control mechanism which acts as a natural self-protection of the lakes against eutrophication. The most probable hypotheses to answer the question, why calcite precipitation acts as a control mechanism of lake eutrophication, were specified as scenarios and checked by means of the dynamic ecological model SALMO. From the scenario analysis the conclusion can be drawn only that self-flocculation of the algae is the dominating mechanism which is responsible for the self-protection of these lakes against eutrophication. (Author's abstract)
W84-03496

LIGHT ATTENUATION IN ONONDAGA LAKE, NY, USA, 1978,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
S. D. Field, and S. W. Effler.
Archiv fur Hydrobiologie, Vol. 98, No. 4, p 409-421, November, 1983. 5 Fig, 1 Tab, 31 Ref.

Descriptors: *Light penetration, *Lakes, Lake Onondaga, New York, Algae, Phytoplankton, Eutrophication, Light intensity, Productivity.

The partitioning of attenuation of photosynthetically active radiation (PAR) between the phytoplankton of Onondaga Lake and their environment was evaluated for 7 months. The estimates of the attenuation coefficients for chlorophyll-a, k(c), and for water and its nonphytoplankton components were within the range reported in the literature. The phytoplankton of the lake were dominated by chlorophytes. The phytoplankton failed during the study period to reach levels at which self-shading would be a significant influence. One hundred and eighteen parallel observations of light attenuation and chlorphyll-a were included in the analysis. These attenuation characteristics, in combination with the observed chlorophyll-a levels, are interpreted with respect to their influence on the relative rate of integral photosynthesis within the lake. The critical role the assessment of these characteristics plays in the calibration of a phytoplankton productivity model for the lake is described. (Baker-IVI)
W84-03497

DIEL OXYGEN VARIATIONS AND THEIR ECOLOGICAL IMPLICATIONS IN AMAZON FLOODPLAIN LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack, and T. R. Fisher.
Archiv fur Hydrobiologie, Vol. 98, No. 4, p 422-442, Stuttgart, November, 1983. 13 Fig, 1 Tab, 33 Ref.

Descriptors: *Dissolved oxygen, *Diel variations, Mixing, Nutrients, Lago Calado, Brazil, Amazon floodplain, Photosynthesis, Epilimnion, Hypolimnion, Phosphates, Ammonium, Organic matter.

Eighty diel cycles of dissolved oxygen were measured during a sixteen month period in Lago Calado, an Amazon floodplain lake. While planktonic photosynthesis is modest, air-water exchanges, vertical mixing and perhaps advection can strongly influence diel oxygen variations. Influx of oxygen from the atmosphere is a major source of dissolved oxygen. A conspicuous feature of oxygen content is erratic variation between periods of positive or negative rates of oxygen change during both day and night. An important implication of the episodes of vertical mixing indicated by the dissolved oxygen variations is the injection of nutrients such as phosphate and ammonium from the hypolimnion into the epilimnion. Diffusion-corrected, daytime changes in oxygen content clearly indicate that on most days the net dissolved oxygen change is negative. The main implication of this result is that the biota of Lago Calado consumes more organic matter than is produced autochthonously.
W84-03498

THE SEASONAL VARIATION OF ORGANIC CONSTITUENTS IN A EUTROPHIC LAKE, LAKE SUWA, JAPAN; PART II. DISSOLVED ORGANIC MATTER,
Nagoya Univ. (Japan). Water Research Inst.
T. Hama, and N. Handa.
Archiv fur Hydrobiologie, Vol. 98, No. 4, p 443-462, Stuttgart, November, 1983. 11 Fig, 40 Ref.

Descriptors: *Eutrophic lakes, *Lake Suwa, *Japan, *Dissolved organic matter, Carbohydrates, Proteins, Amino acids, Acetic acid, Diatoms, Microcystis, Seasonal variation, Phytoplankton.

Water samples were collected from Lake Suwa, one of the most eutrophic lake in Japan, once a month from April, 1979 through August, 1980 and analyzed for dissolved organic carbon, carbohydrates, protein (including amino acids) and acetic acid. The molecular weight distribution of dissolved organic matter (DOM) in each of the water samples was also tested by the gel-filtration technique. Dissolved organic carbon (DOC) concentrations ranged from 1.4 to 3.4 mg C/L, and varied seasonally in close relation to the seasonal change in the standing stock and species composition of phytoplankton. Diatom and Microcystis aeruginosa had a great influence over the concentration of DOC in this lake. Seasonal distribution profiles of dissolved carbohydrates, protein and acetic acid differed little from that of DOC. Polysaccharides consisting of glucose, galactose, xylose, and rhamnose and of galactose, rhamnose and fucose were found in the water samples when M. aeruginosa and diatom blooms occurred respectively. Extracellular production of polysaccharide(s) by phytoplankton was evidenced. There were seasonal changes in molecular weight distribution of dissolved carbohydrates and proteins. Poly- and oligosaccharides were key substances determining the concentration of dissolved carbohydrate in this lake, while all components of the proteinous materials changed their concentration irrespective of molecular weight. (Moore-IVI)
W84-03499

THE GEOCHEMICAL RECORD OF MAJOR CATIONS AND TRACE METALS IN A PRODUCTIVE LAKE; ANALYSIS OF THINLY SLICED SEDIMENT SAMPLES CHARACTERISED BY DIATOM STRATIGRAPHY,
Freshwater Biological Association, Ambleside (England).
U. Ochsenbein, W. Davison, J. Hilton, and E. Y. Haworth.
Archiv fur Hydrobiologie, Vol. 98, No. 4, p 463-488, Stuttgart, November, 1983. 6 Fig, 6 Tab, 51 Ref.

Descriptors: *Geochemistry, *Trace metals, *Diatoms, *Sediments, Minerals, Heavy metals, Water pollution sources, Lead, Cadmium, Zinc, Stratigraphy, Blelham Tarn, England.

The concentration-depth behavior of Mg, K, Al, Fe, Mn, Cu, Ni, Zn, Cd, Pb, C, percentage mineral matter and water content of a sediment core from Blelham Tarn, a small productive lake in the English Lake District, was examined at 0.5 intervals over a 600 year period. Detailed algal stratigraphic evidence suggested that the supply of all elements is free from large annual fluctuations. Peaks in the concentration of carbon, iron and other trace metals were tentatively attributed to an inflow of humic material. X-ray diffraction analysis of the minerals showed that leaching of Mg from chlorite has not played a significant role in its recruitment to the sediments. Mg, K, Al, Fe and Ni were largely of mineralogical origin. The profile shapes of organic carbon and manganese are related and can be rationalized in terms of the rapid redox cycling of manganese at the sediment-water interface. Pb, Cd and Zn all show elevated concentrations, which systematically decrease during the past 10 years. Consideration of fluxes indicates that this pollution can not be accounted for by direct deposition of air-borne metal onto the lake surface. Elevated anthropogenic Pb concentrations appear before the equivalent increase in other metals. (Author's abstract)
W84-03500

COMPOSITIONAL CHANGES OF FATTY ACIDS IN PARTICULATE MATTER AND WATER TEMPERATURE, AND THEIR IMPLICATIONS TO THE SEASONAL SUCCESSION OF PHYTOPLANKTON IN A HYPEREUTROPHIC LAKE, LAKE KASUMIGAURA, JAPAN
Tsukuba Univ., Ibaraki (Japan). Inst. of Biological Sciences.
T. Miyazaki.
Archiv fur Hydrobiologie, Vol. 99, No. 1, p 1-14, December, 1983. 6 Fig, 31 Ref.

Descriptors: *Fatty acids, *Lakes, Japan, Lake Kasumigaura, Eutrophication, Seasonal variations, Phytoplankton, Temperature effects, Water temperature, Particulate matter, Sediments.

Seasonal succession of phytoplankton in lake ecosystems takes place through interactions of physical, chemical, and biotic factors. Temperature, among others, affects many biochemical reactions of phytoplankton, and is one of the most important factors in understanding mechanisms of the seasonal succession. Fatty acids were considered to originate from phytoplankton because of a good correlation between the amounts of fatty acids and chlorophyll-a. The percentage of unsaturated fatty acids showed a remarkable relation to water temperature: the percentage was higher and constant at lower temperatures and decreased to about 40% as temperature increased to 28 degrees C. However, this percentage had no correlation with the amount of inorganic nitrogen. These findings suggest that water temperature played an important role in determining the percentage of unsaturated fatty acids in phytoplankton. Moreover, fatty acid composition and chlorophylls-b and c varied correspondingly, reflecting the change in phytoplankton species throughout the year. (Baker-IVI)
W84-03501

DEGRADABILITY OF DISSOLVED ORGANIC LAKE WATER COMPOUNDS IN CULTURES OF NATURAL BACTERIAL COMMUNITIES
Konstanz Univ. (Germany, F.R.). Limnologic Inst.
A. Geller.
Archiv fur Hydrobiologie, Vol. 99, No. 1, p 60-7 December, 1983. 8 Fig, 3 Tab, 30 Ref.

Descriptors: *Dissolved solids, *Biodegradatio *Bacteria, Lakes, Chemical properties, Dissolve organic carbon, Microbial degradation.

Dissoved organic matter in lakes is mainly com posed of a range of oligomeric to macromolecul compounds derived from autochthonous produ tion and allochthonous input. Ninety percent dissolved organic carbon (DOC) of Mindelsee co sisted of macromolecular (MW > or = 1500) ar oligomeric (MW 400-800) components which we isolated during the four seasons. The compoun were subjected to degradation by natural bacteri communities present in the lake at the same tim Regardless of season the lake water constituen were largely resistant to microbial attack duri

the three months incubation period in four of five experiments as shown by DOC measurements. Refractory macromolecules and oligomers depressed growth of bacteria as established by the microcolony method. Less persistent macromolecules found in one of the experiments, consisted of minor constituents which were utilized by various bacteria and a remainder which was decomposed only by specialists forming characteristic microcolonies. Accompanying oligomers consisted of 40%-50% of readily degradable substances and of a remainder, which was inaccessible to the major part of the bacteria. (Murphy-IVI)
W84-03503

2I. Water In Plants

GROWTH KINETICS OF MICROCYSTIS AERUGINOSA (KUTZ) KUTZ AS A BASIS FOR MODELLING ITS POPULATION DYNAMICS,
Humboldt-Univ. zu Berlin (German D.R.). Sektion Biologie.
A. Nicklisch, and J.-G. Kohl.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 3, p 317-326, 1983. 1 Fig, 4 Tab, 33 Ref.

Descriptors: *Algal growth, *Population dynamics, *Lakes, *Microcystis, Growth, Kinetics, Eutrophication, Nutrients, Temperature effects, Light intensity, Water quality, Algae.

The dependence of the specific growth rate of Microcystis aeruginosa (Kutz) Kutz f. aeruginosa upon temperature and light intensity was determined under continuous illumination by the analysis of the exponential growth period in batch cultures. Light dependence at the optimum temperature is well described by Michaelis-Menten kinetics. The maximum specific growth rate decreases with decreasing temperature, but the initial slope of the curve does not change, although the flexure of the light dependence curve increases. Therefore, the light dependence at lower temperatures is better described by the model of Smith. The Kf values for the light dependence curves decrease with temperature in about the same manner as the maximum specific growth rates. The temperature dependence of the specific growth rate up to the optimum is well described by a sigmoid curve. The results regarding the interaction between temperature and light can be described by combining the light and temperature dependence. The Ks values for orthophosphate, nitrate and ammonium were determined at 25 degrees C and 24 W/sq m light intensity by measuring the steady state nutrient concentrations of nutrient limited chemostat cultures at a dilution rate of 0.5 micromax. The values obtained characterize M. aeruginosa as an alga of eutrophic waters which reaches high growth rates at even moderate phosphate and nitrate concentrations. (Baker-IVI)
W84-02954

THE RELATIONSHIP BETWEEN NUTRIENT AVAILABILITY, SHOOT BIOMASS AND SPECIES RICHNESS IN GRASSLAND AND WETLAND COMMUNITIES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Landscape Ecology and Nature Management.
J. G. Vermeer, and F. Berendse.
Vegetatio, Vol. 53, No. 2, p 121-126, September, 1983. 2 Tab, 29 Ref.

Descriptors: *Wetlands, *Grasslands, *Biomass, Nutrients, Moisture availability, Eutrophication, Fens.

A possible relationship between shoot biomass, nutrient concentration in the soil and number of species per unit area was studied in two different parts of the Netherlands: the Gelderse Vallei and the Westbroekse Zodden. Samples were taken of four series of vegetation and soil studies. One series was located in grassland and wetland communities, one in grassland communities, one in fen communities and one series in only one wetland community. The two series in grassland communities showed a negative correlation between shoot biomass and nutrient concentration in the soil. The opposite was found in the series in the fen communities: there was a positive correlation between species number and shoot biomass and a negative correlation between shoot biomass and nutrient concentrations. The series of samples that had been taken in only one wetland community showed an optimum curve for the relation between shoot biomass and number of species. In the plant communities studied the species richness per unit area increases with increasing productivity at low production levels of less than 400-500 g/sq m, and decreases with increasing productivity at higher production levels greater than 400-500 g/sq m. It is possible to construct an optimum curve for the relationship between species number per unit of area and shoot biomass from these findings. However, the optimum can be expected to differ from one plant community to another. (Baker-IVI)
W84-02974

THE DERIVATION AND VALIDATION OF A NEW MODEL FOR THE INTERCEPTION OF RAINFALL BY FORESTS,
Oregon Univ., Eugene. Dept. of Biology.
W. J. Massman.
Agricultural Meteorology, Vol. 28, No. 3, p 261-286, 1983. 3 Fig, 3 Tab, 44 Ref. NSF Grant DEB 80-07542.

Descriptors: *Rainfall, *Forests, Canopy, Model studies, Forest hydrology, Mathematical equations, Storms, Precipitation, Vegetation effects, Evaporation, Interception, Drainage, Water loss, Interception loss.

A dynamic model and an analytical model derived from it can predict the gross interception of forest canopies. The dynamic model is validated using a running balance in time between rainfall, throughfall, evaporation and changes in the canopy storage. The canopy storage is increased by rainfall interception and depleted by evaporation and drainage. The evaporation rate varies with the amount of water in the canopy and is estimated by numerical methods because sufficient meteorological data is not available. Drainage rate expressions are shown to be inadequate during the period of rainfall. A new drip expression which explicitly includes the rain rate, in addition to the stored water, is proposed and tested and found to fit the observed drip rate better, giving significantly better model prediction with fewer empirical parameters than the exponential form of drip rate. The dynamic model was simplified to an analytical model for predicting the gross interception loss. This analytical expression is easier to use as it is not sensitive to the exact value of the drip parameters. It predicted the total observed gross interception loss for the 20 storms tested to within 4%. The new drip expression is recommended for use in the dynamic model as it described better the dislodgement of peviously intercepted rain droplets by falling rain droplets. A new model for estimating evaporation rates from forest canopies is also proposed. The evaporation model was derived assuming that the thermal diffusivity is a constant throughout the tree canopy and that the Bowen ratio and other micrometeorological parameters can be suitably averaged over the duration of a rainstorm. (Baker-IVI)
W84-03205

WATER STRESS AND WATER-USE EFFICIENCY IN FIELD GROWN WHEAT: A COMPARISON OF ITS EFFICIENCY WITH THAT OF C4 PLANTS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
P. K. Aggarwal, and S. K. Sinha.
Agricultural Meteorology, Vol. 29, No. 3, p 159-167, 1983. 3 Fig, 1 Tab, 26 Ref.

Descriptors: *Water stress, *Plant growth, *Water use efficiency, Wheat, Canopy, Evaporation, Drought, Irrigation, Regression analysis, Statistical studies.

Breeding for water-use efficiency (WUE) is an important objective for the improvement in grain yield of crops grown in rain-fed areas. Water-use efficiency can be improved by either reducing the water use or increasing the dry matter production. Two cultivars of wheat, contrasting in their drought resistance characteristics, were grown under irrigated and non-irrigated conditions in the field for two seasons. The WUE ranged from 0.5 to 13.8 g dry matter/kg water used depending upon the growth stage, cultivar and water stress. The average WUE for the season was between 3.34 and 4.70 g dry matter/kg water used. Regression analysis indicated that WUE was a function of dry matter produced and had no direct statistical relationship with the weather parameters. The WUE of plants having the C3 system of photosynthesis, like wheat, need not be poorer than that of plants with the C4 system, if comparisons are made of plants growing in their respective preferred ecological niches. The observed values of WUE in these experiments would be higher still if the weight of roots and loss of water by evaporation were also considered. One possible reason for the difference between these observed values and the reported values of WUE in the literature is that, under conditions of solution cultures or in pots maintained at field capacity, in the absence of canopy effects, a greater vapour pressure gradient would be established between the evaporating surfaces (leaves and soil) and the atmosphere resulting in excessive water loss without any concomitant increase in dry matter production. (Baker-IVI)
W84-03209

WATER BALANCE OF THREE IRRIGATED CROPS ON FINE-TEXTURED SOILS OF THE RIVERINE PLAIN,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
W. K. Mason, W. S. Meyer, R. C. G. Smith, and H. D. Barrs.
Australian Journal of Agricultural Research, Vol. 34, p 183-191, 1983. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Hydrologic budget, *Irrigation, *Soil texture, *Riverine Plain, Maize, Sorghum, Sunflower, Plant growth, Moisture uptake, Capillary conductivity, Crop yield, Soil-water-plant relationships.

Since irrigation from the Murray and Murrumbidgee rivers began on the Riverine Plain of south-eastern Australia, agricultural production has gradually intensified and the amount of water used has increased. Three summer crop species, maize, sorghum and sunflower were grown on three different fine-textured soils of the Riverine Plain in south-eastern Australia. At each site, above-ground growth, phenological development, and root length density were measured in two well-watered plots to determine the water requirements of the plants. Water use, plant water status and final crop yield were measured in the well-watered plots and in one plot per site where irrigation was discontinued around the time that complete crop canopies had developed. Plant available water was estimated from these drying-cycle plots. Crop water use calculated from soil water contents did not agree with estimates from a water balance model at two of the sites, suggesting that capillary rise from shallow water tables was supplying considerable quantities of water to the crops. Using the water balance model to predict actual evapotranspiration (E sub t), after complete canopy development, up to 40% of E sub t, was supplied to well-watered crops from a water table at approximately 1.5 m. At the site without a water table, yields from the drying-cycle plots were severely reduced and the estimate of plant available water (PAW) was thought to be realistic. Where capillary rise or lateral movement of water into the root zone was significant, the concept of plant available water (PAW) was unsatisfactory. (Murphy-IVI)
W84-03238

PERENNIAL RYEGRASS GROWTH, WATER USE, AND SOIL AERATION STATUS UNDER SOIL COMPACTION,
Kansas State Univ., Manhattan. Dept. of Horticulture.
K. J. O'Neil, and R. N. Carrow.

Agronomy Journal, Vol. 75, No. 2, p 177-180, March-April, 1983. 5 Tab, 24 Ref.

Descriptors: *Perennial Ryegrass, *Plant growth, *Water use, *Soil aeration, *Soil compaction, Soil physical properties.

Soil compaction is a serious problem on recreational turfgrass sites because the altered soil physical properties can adversely affect plant growth and irrigation management. Soil compaction was examined in a greenhouse study for its effect on turfgrass growth, water use, and soil aeration using a Chase silt loam soil (fine, montmorillonitic, mesic, Aquic Arquidolls). Perennial ryegrass (Lolium perenne L. 'Derby') was subjected to three compaction levels: 1) none-no compaction, 2) moderate-360 joules energy, and 3) heavy-720 joules energy. The soil was compacted by dropping a 11.5 kg weight from a height of 65 cm. When tenslometers (installed at a depth of 5 cm) read-0.65 bar, 5 cm of water was applied. Pots were 30.5 cm I.D. by 76.2 cm long PVC pipe with bottom drainage. Soil compaction increased bulk density; reduced aeration porosity, visual quality, and shoot density; altered root distribution, and reduced root density in the 10 to 25 cm soil zone. It had, however, slight effect on verdure and individual shoot weight. Total clipping weights were reduced by 38 and 53% for the moderate and heavy compaction treatments, respectively. Clipping yield decreased immediately after compaction treatment, while root changes were not apparent until after 12 weeks. Water use was reduced by 21 and 49% for the moderate and heavy compaction treatments, respectively. Water extraction from the 10 to 25 cm soil zone decreased from 69 to 27% of the total water extracted in the heavy compacted pots by the end of the study. With heavy compaction, oxygen diffusion rates (ODR) were below 20 x ten to the minus 9th power g/sq cm/min for at least 53 hours after irrigation. The noncompacted soil achieved acceptable ODR within 5 hours. The combined effects of compaction reducing rooting, slowing shoot growth, and increasing moisture retention, caused the compacted soil to remain at a reduced aeration status longer than the noncompacted soil after irrigation. (Murphy-IVI)
W84-03240

ROOT DISTRIBUTION AND WATER USE EFFICIENCY OF ALFALFA AS INFLUENCED BY DEPTH OF IRRIGATION,
Mississippi State Univ., Mississippi State. Dept. of Agronomy.
F. Jodari-Karimi, V. Watson, H. Hodges, and F. Whisler.
Agronomy Journal, Vol. 75, No. 2, p 207-211, March-April, 1983. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Root distribution, *Water use efficiency, *Alfalfa, *Irrigation, Irrigation effects, Irrigation efficiency, Moisture availability, Moisture stress, Evapotranspiration.

Root distribution of several crop plants is affected by different patterns of soil moisture. In alfalfa (Medicago sativa L.), however, such results have not been consistently obtained under field conditions. The effect of different irrigation depths on alfalfa water use efficiency, water extraction patterns, and root distribution under greenhouse conditions where examination of the entire root systems was possible could reveal effective and efficient means for irrigating alfalfa. 'Climmaron' alfalfa was planted in polyvinylchloride (PVC) containers (120 x 30 cm) filled uniformly with a Leeper fine (fine, montmorillonitic, nonacid, thermic Vertic Haplaquept) sandy loam top soil. Irrigation treatments included: watering to saturate the soil one-third of the whole root depth, watering to saturate the soil two-thirds of the whole root depth, and no irrigation. Irrigation was applied when available soild moisture content within the root zone reached 35% (-2.5 bars soil matric potential). The parameters studied included root distribution pattern, total root growth, water extraction pattern, and water use efficiency. The efficiency of water use was higher in deeply irrigated treatments than in shallow irrigated treatments during June and July (a period of high evapotranspirational demand), but it was not different during September to November. Depth of irrigation did not affect total root production, but it did affect root distribution at the irrigation zone. Deeply irrigated plants produced slightly more roots in the lower depths than shallow irrigated plants. Root production of nonirrigated alfalfa was low under the high evaporational demand conditions which occurred during June and July, but was highest among all treatments during the September to November growing period. Root:shoot ratios of 0.28, 0.22 and 0.62 observed in shallow, deep, and non-irrigated plants grown in the September to November period, respectively, indicate that the rate of root growth was increased in nonirrigated alfalfa as a result of limited water stress and under low evapotranspirational demand. (Murphy-IVI)
W84-03241

TILLAGE AND CULTURAL MANAGEMENT OF IRRIGATED POTATOES,
Iowa State Univ., Ames. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W84-03242

WHEAT DEVELOPMENT AS AFFECTED BY DEFICIT, HIGH FREQUENCY SPRINKLER IRRIGATION,
Agricultural Research Service, Prosser, WA.
A. N. Hang, and D. E. Miller.
Agronomy Journal, Vol. 75, No. 2, p 234-239, March-April, 1983. 5 Fig, 4 Tab, 17 Ref. Washington State Univ. Coll. of Agriculture Research Center project 0481.

Descriptors: *Wheat, *Water deficit, *Sprinkler irrigation, Irrigation effects, Water stress, Plant growth, Soil types, Loam, Evpotranspiration.

An important limitation to wheat production worldwide is insufficient water. Therefore, it is important to know how the crop responds physiologically to water stress. Variable irrigation treatments were initiated at pre-or early-boot stage of Fielder spring and Nugaines winter wheat (Triticum aestivum L. em. Thell.) grown on sandy (mixed, mesic, Xeric Torripasamments) and loam (coarse-silty, mixed, mesic Xerollic Camborthids) soils. Different amounts of irrigation water were applied by the line source technique. Daily irrigation near the line source was equivalent to 1.00 (loam) or 1.15 (sand) times estimated evapotranspiration (ET). Pan evaporation (EP) estimated ET as ET = 0.95 EP. On sandy soil, stress symptoms were first observed in plants receiving the least irrigation water (23% estimated ET) 2 weeks after treatments were initiated. Symptoms included decreased number of green leaves, shorter plants, fewer heads, increased specific leaf weight and increased leaf-stem dry weight ratios. Head growth rates were from 8.2 to 15.6 mg/head/day, at the lowest and highest applications, respectively. Reproductive growth rate, crop growth rate, and partitioning to reproductive growth increased with increased irrigation. Effects of decreased irrigation were less on loam soil than on sandy soil. Stress symptoms did not appear until late in the growing season. There were significant differences in plant height, total plant weight, and head weight between the plots receiving highest and lowest irrigation rates (100 vs. 20% estimated ET). Results indicate that normal growth and yield of wheat grown on sandy soil require irrigations that approach ET. However, on loam soil irrigation amounts can be decreased 40 to 50% without affecting developing of plant parts. (Murphy-IVI)
W84-03243

IRRIGATION REGIME EFFECTS ON SOME PHYSIOLOGICAL RESPONSES OF POTATO,
Agricultural Research Organization (Israel). Gilat Regional Experiment Station.
D. Shimshi, J. Shalhevet, and T. Meir.
Agronomy Journal, Vol. 75, p 262-267, March-April, 1983. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Irrigation program, *Irrigation effects, *Physiological ecology, *Potato, Water stress, Leaf permeability, Leaves, Evapotranspiration, Trickle irrigation, Plant water potential.

Potato is relatively sensitive to water stress, and therefore indices for characterizing the degree o water stress and its relation to tuber yield ar sought. During a series of field irrigation experi ments on potatoes (Solanum tuberosum L.) con ducted on a calcic haploxeralf in the Negev regio of Israel, data were collected on leaf permeabilit (LP), leaf and tuber water potential (psi sub l an psi sub t, respectively) and photosynthetic rate with the aim of relating the variables to a range o water stresses caused by the ratio irrigation/evapo ration (K sub p). Leaf permeability was linearl related psi sub l, which ranged from -0.7 kJ/kg i well irrigated plants to -1.4 kJ/kg in severel water-stressed plants. Tuber water potential, ps sub t, was higher by 0.4 to 0.7 kJ/kg than psi sub l the difference increasing with water stress. I trickle-irrigated plants psi sub l of tubers growin in dry soil was lower by 0.06 to 0.12 kJ/kg than ps sub t of tubers growing in wet soil, even thoug the tubers were attached to the same stem. Photo synthesis increased with LP up to 0.8 mg CO2/s m/sec and declined with plant age independentl of LP. Marketable yield was well related to bot seasonal LP and psi sub l; all three variables de creased when K sub p dropped below 1.0. Lea permeability seems to be a better index than lea water potential for the characterization of wate stress of potato in the field. (Author's abstrac
W84-03244

FIELD EVALUATION OF A WATER RELA TIONS MODEL FOR SOYBEAN. I. VALIDIT OF SOME BASIS ASSUMPTIONS,
B. Zur, J. W. Jones, and K. J. Boote.
Agronomy Journal, Vol. 75, p 272-280, March April, 1983. 6 Fig, 1 Tab, 17 Ref. USDA gra 801-15-58.

Descriptors: *Field tests, *Model studies, *Soy bean, Water potentials, Stomatal transpiratio Moisture profiles, Drying.

Basic assumptions made in a model of stomat feedback control, transpiration, and carbon dioxid exchange rate (CER) were tested on soybean (Gly cine max L. Merr cv. Williams) grown in the fie on an Arredondo fine sand soil. Intensive measur ments were made of diurnal fluctuations in le water potential, stomatal resistance, transpiratio rate (TR), and canopy CER during a drying cyc corresponding to the mid-to-late pod-filling perio of the crop. A threshold leaf water potential initia ing stomatal closure at -1.6 MPa was measured the field and verified the relationship assumed the model. Linear relationships between transpir tion rate and both radiation flux and vapor pre sure deficit were found to exist only in well-w tered plants having low stomatal resistances (1 to sec/cm). Following the time when stomatal cl sure was initiated, the dependence of transpiratio rate on climatic variables quickly dissipated. Tra spiration rate was independent of stomatal resis ance for fully open stomata, quickly decrease following stomata closure and remained essential constant at high stomatal resistance. This overa behavior was satisfactorily described by a modifie Penman equation which includes a stomatal resis ance term. A curvilinear relationship betwe CER and photosynthetically active radiation flu (PAR) existed as long as stomata were fully ope Following stomata closure, CER was independe of PAR above 500 microE/M2.sec (full sunlight 2,100 microE/m2.sec). The dependence of CER stomatal resistance was similar to that of transpir tion rate but with greater sensitivity. (Autho abstract)
W84-03245

FIELD EVALUATION OF A WATER REL TIONS MODEL FOR SOYBEAN, II. DIURNA FLUCTUATIONS,
Florida Univ., Gainesville. Dept. of Agricultur Engineering.
J. W. Jones, B. Zur, and K. J. Boote.
Agronomy Journal, Vol. 75, No. 2, p 281-28 March-April, 1983. 10 Fig, 7 Ref. DA grant 80 15-58.

Descriptors: *Field tests, *Model studies, *Diurnal distribution, Water potentials, Plant water potential, Transpiration, Drying, Soil-water-plant relationships, Soil physical properties.

A field study was conducted on soybeans (Glycine max L. Merr. cv. Williams) growing in Arredondo fine sand, a member of the hypothermic, coated family of Typic Quartzipsamments to determine the effects of drying cycles on plant water relations for comparison with results predicted by a dynamic model. Two different drying cycle treatments were imposed on different plots during late vegetative development and mid-to-late pod fill stages and well irrigated plots were maintained for comparison. Every other day during each drying cycle, hourly measurements of leaf water potential, canopy carbon exchange rate (CER), and canopy transpiration were measured on dry and wet plots. During the initial phases of the drying cycles leaf water potential, transpiration, and CER followed diurnal cycles closely related to radiation flux. This response lasted for 9 and 5 days during the first and second drying cycles, respectively, when crop water deficits reached critical levels causing leaf water potentials of -1.4 and -1.7 MPa. After these critical time periods, midday leaf water potentials became relatively stable with time whereas transpiration and CER decreased such that diurnal fluctuations disappeared. The model was successful in simulating diurnal patterns of these variables for the crop exposed to the two drying cycles. (Author's abstract)
W84-03246

CROP YIELD - IRRIGATION RELATIONSHIPS IN A GYPSIFEROUS-SODIC SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
For primary bibliographic entry see Field 3F.
W84-03248

ALFALFA RESPONSES TO IRRIGATION TREATMENT AND ENVIRONMENT,
Agricultural Research Service, Riverside, CA. Salinity Lab.
T. J. Donovan, and B. D. Meek.
Agronomy Journal, Vol. 75, p 461-464, May-June, 1983. 6 Fig, 1 Tab, 18 Ref.

Descriptors: *Alfalfa, *Irrigation effects, Irrigation requirements, Water management, Plant water potential, Crop yield, Evapotranspiration, Water use efficiency.

Water management is critical for maximum production of alfalfa (Medicago sativa L.) with under irrigation resulting in loss of production and over irrigation resulting in a loss of stand. To determine the optimum irrigation rates under high evaporative demand growth of alfalfa was evaluated on replicated plots (6 X 6 m) established on a fine textured soil (Typic Torrifluvent, clayey over loamy, montmorillonitic, calcareous hyperthermic family) and differentially irrigated from July 1975 to January 1978. The irrigation treatments were applied at 56, 66, 75 (best estimate of Et), and 84% of pan evaporation (Ep) and described as dry, semidry, optimum and wet, respectively. Alfalfa yields increased with increase in water applied. Irrigation at 84% Ep for leaching did not enhance yield over the optimum water treatment possibly because of reduced stand from waterlogging. The protein concentration of alfalfa was higher in dry than in wet treatments in March and November. During the summer, plant temperatures in the dry treatment were up to 7 C higher than in the wet treatment. (Murphy-IVI)
W84-03249

TURFGRASS GROWTH, N USE, AND WATER USE UNDER SOIL COMPACTION AND N FERTILIZATION,
Kansas State Univ., Manhattan. Dept. of Horticulture.
M. J. Sills, and R. N. Carrow.
Agronomy Journal, Vol. 75, p 488-492, May-June, 1983. 4 Tab, 22 Ref.

Descriptors: *Plant growth, *Nitorgen, *Water use, *Soil compaction, *Fertilization, Water use efficiency, Plant water potential, Environmental effects, Plant growth substances.

Soil compaction is a problem in many turf areas. Perennial ryegrass (Lolium perenne L. 'Pennfine') was subjected to two compaction treatments with an 11.5 kg falling weight: a) none and b) heavy-874 J energy. Two parts of fine, montmorillonitic mesic, Aquic Argiudoll soil (Chase silt loam) was used to one part medium silica sand by volume. Fertilization rate treatments were 0.5 and 1.0 kg N/100sq m. Nitrogen carrier treatments were water soluble N applied as NH4NO3 and water insoluble N applied as IBDU (isobutylidine diurea). Compaction increased bulk density, water retention, and soil strength, while decreasing aeration porosity. Visual quality, clipping yield, N use per unit area of sod, evapotranspiration, and root growth declined with compaction. Verdure, total nonstructural carbohydrates (TNC), and percent N in leaf tissue were not affected by compaction. Initial TNC levels, water use efficiency, and N use per unit area, increased as N rate increased. Clipping yield, N use per unit area, and water use efficiency were higher with a water-soluble N carrier. Percent N in leaf tissue, early in the study, increased with water-insoluble fertilizer. The most detrimental effects of compaction were on root weight and distribution at the high N rate. Application of high N did not compensate for the adverse effects of compaction. (Murphy-IVI)
W84-03250

WETTING AND MATURITY EFFECTS ON THE YIELD AND QUALITY OF LEGUME HAY,
Wisconsin Univ.-Madison. Dept. of Agronomy.
M. Collins.
Agronomy Journal, Vol. 75, p 523-527, May-June, 1983. 4 Tab, 16 Ref.

Descriptors: *Wetting, *Maturity, *Crop yield, *Legumes, Rainfall impact, Moisture stress, Moisture uptake, Alfalfa, Red clover, Dry matter.

Information is needed on the effects of rain on the magnitude of yield and quality losses of field cured legume hay. Three and one-half kilogram samples of alfalfa and red clover forage grown on Plano silt loam soil (fine-silty, mixed, mesic Typic Argiudoll) and harvested at early and late maturity stages were placed on wire screens and allowed to dry without wetting or were exposed to natural or artificial wetting in 1980 and 1981. A completely randomized design was used with three replications in 1980 and two in 1981. In 1980, 2.5 cm of water was applied to hay wetted during drying. In 1981, hay wetted during drying was exposed to 4.1 and 6.2 cm of precipitation, respectively. Mean dry matter (DM) losses during drying in 1980 were 8.1 and 17.0% from unwetted and wetted forage, respectively, but red clover harvested at the bud stage and wetted lost 25.8% of the total DM. In 1981 unwetted forage, forage wetted during drying and forage wetted after reaching 85% DM lost 10.5, 43.4, adn 53.0% of the initial DM. Wetting did not change forage N concentration greatly in either year. Forage in vitro dry matter disappearance (IVDMD) was reduced by wetting in both years. In 1981 IVDMD was reduced from 66.4% for unwetted hay to 48.1% for hay wetted during drying. Mature forage of alfalfa was lower in IVDMD than bud stage alfalfa in both years regardless of wetting treatment. Neutral detergent fiber concentrations was increased by wetting red clover forage in both years. Prolonged wetting in 1981 reduced the yield of N and TNC by 40.3 and 71.5%, respectively. Dry matter and quality losses due to wetting of legume forage during hay curing vary with legume species and the timing and duration of wetting. Results indicate that plant constituents differ in their susceptibility to loss due to wetting during hay curing. (Murphy-IVI)
W84-03253

INFLUENCE OF WATER STRESS ON THE DIURNAL EXCHANGE OF MASS AND ENERGY BETWEEN THE ATMOSPHERE AND A SOYBEAN CANOPY,
National Oceanic and Atmospheric Administration, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab.
D. D. Baldocchi, S. B. Verma, N. J. Rosenberg, B. L. Blad, and A. Garay.
Agronomy Journal, Vol. 75, p 543-548, May-June, 1983. 6 Fig, 1 Tab, 40 Ref. Atmospheric Research Division, NSF grant ATM-7901017.

Descriptors: *Water stress, *Diurnal distribution, Mass, Energy, Atmospheric physics, Water use efficiency, Evapotranspiration, Micrometeorology, Carbon dioxide.

A micrometeorological-physiological study at Mead, Nebr., during the summer of 1980 examines the diurnal exchanges of mass and energy of well-watered and water-stressed soybean (Glycine max (L.) Merr. cy. Harosoy) canopies and relates these exchanges to environmental and physiological variables. Measurements of CO2, latent heat and sensible heat flux uses the Bowen-ratio energy balance technique. The soil of the area is a Sharpsburg silty clay loam (a fine, montmorillonitic, mesic Typic Argiudoll). Water stress greatly influenced the partitioning of available energy between latent and sensible heat flux. When the crop was well-watered, sensible heat (H) was directed toward the crop and caused latent heat exchange (LE) to exceed net radiation (Rn). When the crop was water stressed, only two-thirds of Rn was consumed as LE; the remainder was converted into sensible heat. Since both Rn and vapor pressure deficit were greater on the day when the crop was water-stressed, stomatal closure appears to have been the primary cause of the reduction in LE. Carbon dioxide exchange was not sensitive to water stress in the morning but was severely limited by such stress during midday. The midday reduction in CO2 exchange appears to have been caused by a combination of high stomatal resistance limiting CO2 diffusion to the cell chloroplasts and low leaf water potential coupled with high air temperature affecting the enzymatic reactions associated with photosynthesis. Water use efficiency (defined in terms of the CO2-water flux ratio) was greater when the crop was well-watered than when it was stressed for water. A combination of water stress, a large vapor pressure deficit, and high air temperature reduced the CO2-water flux ratio. (Murphy-IVI)
W84-03254

YIELD AND WATER USE EFFICIENCY OF GRAIN SORGHUM IN A LIMITED IRRIGATION-DRYLAND FARMING SYSTEM,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
B. A. Stewart, J. T. Musick, and D. A. Dusek.
Agronomy Journal, Vol. 75, p 629-634, July-August, 1983. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Water use efficiency, *Water yield, *Grain sorghum, *Irrigation, *Dry farming, Net rainfall, Transpiration, Evapotranspiration, Furrow dams, Water management, Soil-water-plant relationships.

A Limited Irrigation-Dryland (LID) farming system, for the conjunctive use of rainfall and limited irrigation of graded furrows, actually adjusts, during the crop growing season, the amount of land irrigated since more land can be irrigated during above-average rainfall years with a limited amount of irrigation water than during below-average years. The design used a limited water supply to irrigate a larger area than could be conventionally irrigated. A graded furrow field, 600 m long on a 0.3 to 0.4% slope was divided into three water management sections. The upper half of the field was managed as 'fully irrigated.' The next one-fourth was managed as a 'tailwater runoff' section that utilized furrow runoff from the fully irrigated section. The lower one-fourth was managed as a 'dryland' section capable of utilizing runoff from either rainfall or irrigation on the wetter sections. The system was field tested for 3 years with grain sorghum (Sorghum bicolor (L.) Moench) on a Pullman clay loam (fine, mixed, thermic family of Torretic Paleustolls). Seasonal rainfall values were 224 mm in 1979, 103 mm in

1980, and 424 mm in 1981 as compared to the average of about 250 mm. The LID system was successful in increasing the utilization efficiency of irrigation water. Irrigation water added to a field can be transpired, evaporated, percolated, lost as runoff, or left stored in the soil after harvest. The LID system tended to reduce all losses other than transpiration. When 125 mm or 185 mm of irrigation water were added with the LID system, the evapotranspiration by grain sorghum was increased by an almost equal amount. This increased grain yield an average of 154 kg/ha for each 10 mm added irrigation, compared to 92 kg/ha for each 10 mm under conventional irrigation practices. (Murphy-IVI)
W84-03258

NITROGEN FIXING ACTIVITY OF WATER STRESSED SIRATRO,
Texas A and M Univ., College Station. Dept. of Range Science.
M. Ismaili, D. D. Briske, and R. W. Weaver.
Agronomy Journal, Vol. 75, p 649-653, July-August, 1983. 4 Fig, 12 Ref.

Descriptors: *Nitrogen fixing, *Water stress, *Siratro, Water potentials, Drought, Soil water potential, Plant water potential, Nitrogen, Soil-water-plant relationships, Leaves.

Siratro 'Macroptilium atropurpureum (DC.) Urb.cv.siratro' is grown in tropical and subtropical environments characterized by frequent periods of drought and is dependent on N2 fixation for its N. Leaf and nodule water potentials to N2 (C2H2) fixing activity and the capability of nodules to recover N2 (C2H2) fixing activity forty-two days after planting four water treatments were imposed by withholding water for increasing periods of time. This created a decrease in leaf and nodule water potentials corresponding to the period of time water was withheld. However, when water potentials decreased below -1.5 MPa, nodule water potentials became more negative than leaf water potentials. A similar decrease in water potential suppressed growth of both nodules and shoots. In the longer duration, water withholding treatments nodule and shoot weights decreased as a result of nodule sloughing and leaf shedding. All water withholding treatments reduced the rate of N2 (C2H2) fixing activity. Nodules with water potentials of -1.5 MPa or greater were able to regain much of their N2 (C2H2) fixing activity within 2 d following rewatering. The specific activity of nodules surviving the most severe level of water stress (-1.9 MPa) were only about 60% as active as the control 6 d following rewatering. Nodules were irreversibly inactivated by water stress more severe than -3.0 MPa but in approximately 12 d following rewatering new nodules developed. Regrowth of siratro following water stress may be delayed while the capacity for N2 fixation recovers. (Murphy-IVI)
W84-03259

EFFECTS OF IRRIGATION ON ACCUMULATION OF SOIL AND SYMBIOTICALLY FIXED N BY SOYBEAN GROWN ON A NORFOLK LOAMY SAND,
Agricultural Research Service, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
T. A. Matheny, and P. G. Hunt.
Agronomy Journal, Vol. 75, No. 5, p 719-722, September-October, 1983. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Irrigations effects, *Nitrogen, *Accumulation, *Soil, *Soybean, *Loamy sand, Drought, Water management, Nitrogen fixation, Comparison studies.

In the southeastern Coastal Plain, soybean (Glycine max (L.) Merr.) is normally grown on soils that are often exposed to drought and leaching rains as well as being low in available N. This field study evaluates the impact of water management on accumulation of soil and symbiotically fixed N by soybean grown on these type soils. Nodulating and nonnodulating isolines of 'Lee' cultivar soybean were grown under irrigated and nonirrigated conditions in 1979 and 1980 on a Norfolk loamy sand (fine-loamy, mixed, mesic Typic Paleudults). A period of excessive rainfall occurred in 1979, while a major drought occurred in 1980. Irrigated treatments had lower soil-NO3(-) concentrations in the Ap horizon than nonirrigated treatments during 1979, but there was no effect of irrigation on soil NO3(-) in 1980. Dinitrogen fixation, as estimated by the difference in N accumulation between nodulating and nonnodulating isolines, accounted for 76 to 91% of total plant N in the irrigated plots and 55 to 60% in the nonirrigated plots. Total plant N fixed exceeded 1100 mg/plant for the irrigated plots in 1979 and 1980. Maximum N accumulation for the nodulating isoline occurred in the nonirrigated plots in 1979 and in the irrigated plots in 1980. However, the nonnodulating isoline had maximum accumulations of both N and dry matter in the nonirrigated treatments in both 1979 and 1980. The number of nodules/plant and the C2H2(-) reducing activity were significantly higher in the irrigated plots during the pod growth stages in 1980. Irrigation did not significantly affect seed yield of nodulating Lee soybean in 1979, but did result in a twofold increase in 1980. The effects of irrigation on the Lee nonnodulating isoline resulted in a positive yield response in 1980, but a negative response in 1979. These findings show that a major portion of the N-requirement for soybean in the southeastern Coastal Plain is met by fixation and that the relative importance of fixed N may vary substantially with rainfall patterns and irrigation. (Murphy-IVI)
W84-03260

SOIL WATER AND POPULATION INFLUENCE ON HYBRID SUNFLOWER YIELD AND UNIFORMITY OF STAND,
North Dakota State Univ., Fargo. Dept. of Soil Science.
L. Prunty.
Agronomy Journal, Vol. 75, p 745-749, September-October, 1983. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Soil water, *Population, *Sunflower, *Yield, *Stem, Soil water potential, comparison studies, Irrigation effects.

Sunflower (Helianthus annuus L.) hybrids do not respond identically to agronomic and environmental variables. The present study quantifies the influence of soil water potential and plant population on oilseed sunflower hybrids 'Dahlgren 704', 'USDA 894', and 'Interstate 907'. Desire to refind knowledge of yield relationships was one motivation for the study, but a deeper stimulus was the need for basic knowledge of the detailed nature of sunflower stands. One plot site had Maddock (sandy, mixed Udorthentic Haploboroll) and Gardena (coarse-silty, mixed pachic Udic Haploboroll) soils. This location received irrigation treatments limiting soil water potentials to minimums of -35, -70, and -105 J/kg. The second site had Bearden (fine-silty, frigid Aeric Calciaquoll) soil and was not irrigated. Yield increased with soil water potential from 201 g/sq m at -105 J/kg to 284 g/sq m at -35 J/kg. Dryland yields were 200, 179, and 164 g/sq m for hybrids 894, 704, and 907. Population did not influence yields. However, irrigated and nonirrigated stand loss percentages increased with population at 0.8 and 2.2% per plant per square meter, respectively. Knowledge of the threshold population for stand loss provides a rationale for selection of population in the absence of yield differences because significant stand loss indicates a possibly undesirable level of intraspecific competition. Guidelines for irrigation scheduling for sunflower by use of tensiometers are now on a sounder experimental basis. Hybrids similar under irrigation yielded differently under dryland conditions. (Murphy-IVI)
W84-03261

RESPONSE OF DRY BEANS TO DAILY DEFICIT SPRINKLER IRRIGATION,
Agricultural Research Service, Prosser, WA.
For primary bibliographic entry see Field 3F.
W84-03262

ALFALFA STEM AND LEAF GROWTH DURING WATER STRESS,
Wisconsin Univ.-Madison. Dept. of Soil Science.
P. W. Brown, and C. B. Tanner.
Agronomy Journal, Vol. 75, p 799-805, July-August, 1983. 6 Fig, 1 Tab, 22 Ref. ARS project 142-1710.

Descriptors: *Alfalfa, *Leaf growth, *Water Stress, Irrigation effects, Leaves, Water potential, Stomata, Soil-water-plant relationships.

Alfalfa (Medicago sativa L.) requires irrigation in semiarid and arid regions and improved yields often result from irrigation in subhumid and humid areas. Despite the importance of optimizing water management for alfalfa leaf and stem growth, no field study has been reported which relates alfalfa leaf expansion or stem extension to plant water deficits. How does leaf expansion, stem elongation, and stomatal response of alfalfa relate to the water potential in alfalfa, field-grown on Plainfield loamy sand (mixed, mesic Typic Udipsamment). Periodic measurements of alfalfa stem extension and leaf expansion (area derived from length and width measurements) were related to leaf water potential (psi L) measured with a pressure chamber, soil matric potential (psi m, measured with tensiometers, and stomatal conductance measured with porometers. For wellwatered alfalfa, expansion curves of individual leaves were sigmoid-shaped, while internode extensions were nearly exponential with time through about 95% of the total extension. The primary leaf attached at the top of an internode expands to nearly full size before the internode begins rapid extension. The growth of individual leaves and internodes collectively results in nearly constant rates of leaf expansion and stem extension during vegetative regrowth. When psi m at 30 cm decreased to -0.35 bar, afternoon psi L decreased to about -8 bars, about 2 bars below irrigated alfalfa, and both the growth rate (GR) and relative growth rate (RGR) of stressed leaves and stems were significantly less ($p < 0.1$) than well-watered leaves and stems. In stressed treatments, wilting, gray-green canopy color, decreased afternoon stomatal conductance, and a 50% decrease in RGR as compared to irrigated treatments resulted when afternoon psi L decreased to about 15 bars even though psi m exceeded -0.1 bar at 90 and 150 cm. Alfalfa extracted 85% of its total water from the 1st meter of soil prior to the onset of decreased afternoon stomatal conductance, but nearly equal percentages from each of the top 2 m of soil afterward. Little shoot growth occurred when psi L dropped below -10 bars. Development of water stress 2 weeks after cutting reduced alfalfa leaf size, internode length, and dry matter production, but not leaf and internode number or stem density. The percentage of total forage dry weight in leaves (LPDW) decreased linearly with stem height resulting in higher LPDW and a better quality forage in stressstunted forage. Cool night temperatures limited growth of well-waterd alfalfa. (Murphy-IVI)
W84-03263

EFFECT OF WIND ON THE CROP WATER STRESS INDEX DERIVED BY INFRARED THERMOMETRY,
California Univ., Davis.
J. C. O'Toole, and J. L. Hatfield.
Agronomy Journal, Vol. 75, p 811-817, September-October, 1983. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Water stress, *Wind pressure, *Infrared Thermometry, *Temperature, Plant water potential, Canopy, Sorghum, Cotton, Micrometeorology.

A new plant or crop water stress index (CWSI) that depends on interpreting crop or foliage-to-air temperature differential (Tf-Ta) shows promise in both research and irrigation water management. The method relies on the unique relation between Tf-Ta and atmospheric water vapor pressure deficit (VPD). However, the method of estimating the upper limit of Tf-Ta, a critical step in CWSI calculation, was questionable and lacked field validation. The upper limit of Tf-Ta and attendant micrometeorological variables on severely water stressed sorghum (Sorghum bicolor L.), corn (Zea mays L.), and bean (Phaseolus vulgaris L.) grow

on a Typic Xerotherent, and cotton (Gossypium hirsutum L.) grown on a Typic Torriorthent ranged from 2.5 to 8.5C across crops. There was poor agreement between actual and calculated values with respect to net radiation, VPD, and windspeed. Windspeed was found to be the primary factor causing erroneous estimation of the upper limit of Tf-Ta and hence CWSI values. Crop water stress index values measured at low windspeed overestimated the level of water stress while those measured at high windspeed underestimated it. Crop specific changes in the boundary layer resistance-windspeed relationship partially explain the discrepancy between measured and calculated Tf-Ta upper limit values. Modification of the CWSI to account for the influence of windspeed is discussed. (Murphy-IVI)
W84-03265

A METHOD FOR INDUCING CONTROLLED MOISTURE STRESS ON SEEDLINGS,
North Carolina State Univ. at Raleigh. Dept. of Crop Science.
M. Sikurajapathy, J. J. Cappy, and H. D. Gross.
Agronomy Journal, Vol. 75, p 840-843, September-October, 1983. 2 Fig, 3 Tab, 17 Ref. Agency for International Development grant AID/csd 2835.

Descriptors: *Moisture stress, *Seedlings, Soil water, Soil water potential, Soil columns, Water potential, Drought, Rice, Mungbean.

Selectively permeable sleeves filled with soil were held in tanks containing various polyethylene glycol (PEG) 10 000 solutions in order to evaluate seedling tolerance to soil moisture stress. The soil columns, made of 7.6 cm diam dialysis tubing molecular weight (MW) cut off 8000), were fitted to plexiglass bases and placed in tanks containing PEC 10 000 solutions calibrated to provide the desired soil water potentials (-0.01, -0.1, -0.5, and -1.5 MPa). The columns contained 2.5 kg soil. The membrane maintained its integrity over a 30-day period. Soil water moved in response to gradients created by the osmoticum; the small pore size of the permeable sleeves prohibited the PEG from entering the soil. Water loss measured for soil columns immersed in PEG solution maintaining -0.01 MPa potential revealed no movement in either direction. At -0.5 MPa, water moved gradually out of the soil columns. At the lower potentials (-0.01 and -0.1 MPa), rapid movement of water out of the soil occurred within 20 h, leading to a loss of 60% of the water in the columns. Water content at various column depths after 12 and 30 days immersion at the different potentials were very uniform. No detectable amounts of PEG were found in roots, shoots, or leaves of mungbean (Vigna radiata (L.) Wilczek) or rice (Oryza sativa L.). The technique makes possible precise control of water-stress intensity (water potential), water- stress duration, and recovery from water stress. (Author's abstract)
W84-03267

YIELD AND WATER RELATIONS OF PEARL MILLET GENOTYPES UNDER IRRIGATED AND NONIRRIGATED CONDITIONS,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
P. Singh, E. T. Kanemasu, and P. Singh.
Agronomy Journal, Vol. 75, p 886-890, November-December, 1983. 1 Fig, 8 Tab, 19 Ref.

Descriptors: *Crop yield, *Water stress, *Pearl millet, *Irrigation effects, Drought, Plant water potential, Leaves, Water use.

Drought resistance in pearl millet (Pennisetum americanum (L.) Leeke) makes it an important food crop in arid and semiarid regions, but research is limited on drought resistance and physiological responses to water stress. To study the relationship of pearl millet yield to physiological characteristics, 10 pearl millet genotypes were grown under irrigated and nonirrigated conditions on a silt loam soil (fine-silty, mixed mesic, Pachic Haplustoll). Leaf diffusion resistance of adaxial (LDRad) and abaxial (LDRab) surfaces, leaf water potential (psi L), leaf osmotic potential (psi pi L) and stem osmotic potential (psi pi s) of genotypes were recorded in both treatments in the afternoon (1200 to 1700 h) when the crop was water-stressed. Leaf diffusion resistance (LDR) for a leaf was calculated as LDR = (LDRad x LDRab)/(LDRad + LDRab). LDRad, LDRab, LDR, psi L, psi pi L, and psi pi s observed for each genotype were averaged over the stress period and correlated with yields and yield ratios (nonirrigated yield/irrigated yield) of genotypes. Majority of genotypes studies did not differ significantly ($P < 0.05$) in average afternoon LDRab, psi L, psi pi L, psi pi s, and water use (WU) in both the treatments except that genotypic differences were significant in average afternoon LDRad and LDR in the nonirrigated treatment. Grain yield was signficantly correlated with LDRab in both irrigated ($r = -0.90$) and nonirrigated ($r = -0.72$) treatments, suggesting that high LDRab of genotypes is associated with low grain yield. Grain yield ratio was significantly correlated with LDRab ($r = 0.71$) and LDR ($r = 0.66$) in the irrigated treatment and with psi L ($r = 0.64$) and psi pi s ($r = .078$) in the nonirrigated treatment. Average afternoon psi L did not correlate with grain yield or grain yield ratio. It is concluded that average afternoon LDRab could be used to rank pearl millet genotypes for their grain yield in both stressed and nonstressed environment. (Author's abstract)
W84-03269

RELATIONSHIPS BETWEEN LEAF WATER POTENTIAL, CANOPY TEMPERATURE, AND EVAPOTRANSPIRATION IN IRRIGATED AND NONIRRIGATED ALFALFA,
Minnesota Univ., St. Paul.
For primary bibliographic entry see Field 2D.
W84-03270

MAGNESIUM NUTRITION AND GRAIN YIELD OF MAIZE HAVING LOW WATER POTENTIAL,
Navarra Univ., Pamplona (Spain). Dept. Fisiologia Vegetal.
P. M. Aparicio-Tejo, and J. S. Boyer.
Agronomy Journal, Vol. 75, p 919-923, November-December, 1983. 5 Fig, 4 Tab, 18 Ref. NSF grant PCM 79-09790.

Descriptors: *Magnesium, *Maize yield, *Plant water potential, Plant growth substances, Leaves.

Drought decreases plant production but the nutritional status of the plants may alter their susceptibility. Losses in the activity of chloroplast coupling factor could be simulated by concerntrations of Mg slightly higher than those usually present in chloroplasts. Since dehydration might increase cellular ion concentrations, it is possible that the photosynthetic response of plants to low water potentials would reflect at least in part the ion status of the tissues. Plants were grown at two soil Mg levels in a controlled environment capable of providing yields comparable to those in the field. The grain yield, shoot and root dry weight, leaf water potential (psi w) and tissue mineral composition were determined. Immediately after tasseling, water was withheld from the soil of half the plants until the psi w had decreased to -1.8 to -2.0 MPa, where it remained until maturity. Low water potentials resulted in a 50% reduction in grain yield and an accelerated leaf senescence. Despite small but significant differences in Mg concentration in roots, stems, and leaves, no differences attributable to differences in Mg nutrition were found in rate of plant dehydration, dry matter accumulation, or grain yield. Differences in Mg content of the plant either do not influence response to low psi w, or must be larger than achieved to see an effect. (Murphy-IVI)
W84-03272

SOYBEAN WATER STATUS AND CANOPY MICROCLIMATE RELATIONSHIPS AT FOUR ROW SPACINGS,
Agricultural Research Service, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
R. E. Sojka, and J. E. Parsons.
Agronomy Journal, Vol. 75, p 962-968, November-December, 1983. 7 Fig, 1 Tab, 32 Ref.

Descriptors: *Soybeans, *Plant water potential, *Canopy, *Microclimate, *Cultivation, Humidity, Temperature, Moisture availability, Evapotranspiration.

There is little field data relating plant water status and canopy microclimate of determinate soybean 'Glycine max (L.) Merr.' cultivars grown in humid environments. Also, few observations of these parameters have been reported for the period prior to complete canopy closure. A field study in South Carolina in 1979 determines these basic relationships for two determinate soybean cultivars, Davis (Group VI) and Coker 338 (Group VIII) grown in 1.02, 0.76, 0.51 and 0.36-m row spacings. The experiments were conducted on a Norfolk loamy sand (fine-loamy, siliceous, thermic, Typic Paleudult). Thermistor-determined leaf temperatures (T sub L) and ambient temperatures (T sub A) were highly correlated, and no significant improvement in the correlation resulted from treating row spacing or diurnal periods separately. Both T sub L and delta T(T sub L - T sub A) were highly correlated with pressure chamber determination of xylem pressure potential (psi x). Parallel leaf diffusive resistance (Rs) was not highly correlated with any of the canopy microclimate or water status parameters observed. Atmospheric vapor pressure deficit (VPD) was correlated with delta T. Xylem pressure potential was very highly correlated with leaf vapor pressure deficit (LVPD). No row spacing effect on psi x was observed, but mean seasonal midday psi x, was 0.10 MPa lower for Coker 338 than for Davis ($P <$ or $=$ to 0.001) and osmotic potential was 0.20 MPa lower for Coker 338 than for Davis ($P <$ or $=$ to 0.01). The authors propose that the slope of delta T vs. VPD may be influenced by high prevailing relative humidity and heating of the canopy from exposed soil between rows in the period prior to complete canopy coverage. (Murphy-IVI)
W84-03273

ROOT SYSTEM CHARACTERISTICS OF TWO SOYBEAN ISOLINES UNDERGOING WATER STRESS CONDITIONS,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
A. F. Garay, and W. W. Wilhelm.
Agronomy Journal, Vol. 75, p 973-977, November-December, 1983. 2 Fig, 4 Tab, 15 Ref.

Descriptors: *Roots, *Soybeans, *Isolines, *Water stress, Root development, Moisture uptake, Root distribution, Moisture availability.

Environmental stress may have a differential influence on root development of soybean 'Glycine max (L.) Merr.' isolines which vary in pubescence density. Root length density and root dry matter distribution as a function of depth and distance from the row were determined for two isolines of 'Harosoy' soybean in association with an experiment designed to evaluate the influence of epidermal pubescence on root development, water use, and photosynthetic characteristics of the two isolines. The isolines, Harosoy normal (HN) and Harosoy dense (HD), differed in the density of trichomes on the epidermal surfaces of leaves, stems, and pods. Root samples were collected 47 (full bloom) and 78 (beginning seed) days after planting. Until the first sampling, soil water content was high at all depths, and roots were concentrated in the surface 0.15-m layer, especially under the row. Eighty percent of the roots were found within the upper 0.30 m. By 78 days after planting and after 30 days of drought, root length density was greatest at the 0.90 to 1.20-m layer, 80% of the roots were found within the 0 root 1.2-m layer; and uniform lateral distribution was observed. Harosoy dense pubescence isoline tended to have a greater root density, to explore deeper into the soil, and to extract more soil water during the drought than did the normal pubescence isoline. However, the rate of water extraction (per unit root length) was greater for the HN isoline. (Murphy-IVI)
W84-03274

MOISTURE STRESS AND N REDISTRIBUTION IN SOYBEAN,

Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
D. B. Egli, L. Meckel, R. E. Phillips, D. Radcliffe, and J. E. Leggett.
Agronomy Journal, Vol. 75, p 1027-1031, November-December, 1983. 1 Fig, 4 Tab, 21 Ref.

Descriptors: *Moisture stress, *Nitrogen, *Distribution, *Soybean yield, Irrigation effects, Trickle irrigation, Nitrogen fixation.

The redistribution of N from vegetative plant parts to the developing seed of soybean 'Glycine max (L.) Merr.' may influence the duration of seed filling and yield. The objective of this study was to investigate the effect of moisture stress during various developmental stages on N redistribution. Soybean (cv. Williams) was grown in the field at Lexington, Ky., for 3 years (1979 to 1981) on a Maury silt loam (fine, mixed, mesic Typic Paleudalf) soil. Irrigated controls were compared with moisture stress treatments from planting to beginning seed fill (growth stage R5), during seed filling (growth stage R5 to R7) or throughout the growing season. Stress was applied by not irrigating until the soil water potential reached -300J/kg or by covering the soil with black plastic after emergence to allow severe stress to develop. Plant weight at growth stage R5 and yield were affected by the moisture stress treatments, however, moisture stress had only a limited effect on N concentration in the plant tissue. The proportion of seed N that came from redistribution varied among treatments and years from 33 to 102% with no consistent relationship between the level or timing of moisture stress and the contribution of redistributed N to seed N. The proportion of the N in the vegetative plant and pod walls that was redistributed was nearly constant across treatments and years. The contribution that redistributed N makes to the seed N at maturity is more closely related to the amount of N available for redistribution than it is to ability of plants to obtain N from the soil or via N2 fixation during seed filling. (Murphy-IVI)
W84-03275

COMPARATIVE PHYSIOLOGY AND WATER RELATIONS OF TWO CORN HYBRIDS DURING WATER STRESS,
Du Pont de Nemours (E.I.) and Co., Wilmington, DE. Central Research and Development Dept.
R. C. Ackerson.
Crop Science, Vol. 23, No. 2, p 278-283, March-April, 1983. 8 Fig, 26 Ref.

Descriptors: *Corn, *Plant physiology, *Water stress, Plant water potential, Leaves, Drought, Water conveyance.

Water stress usually reduces crop growth and productivity. Although several important physiological processes can be dramatically altered by water stress, it is uncertain which processes are important with respect to adaptation, acclimation tolerance or resistance to drought. One hybrid (XL62AA) was a good drought tolerant commercial hybrid, while the other was an experimental hybrid (LH) derived from a cross of two Latente parents. The hybrids were compared to assess their relative responses to water stress. The LH hybrid exhibited higher rates of leaf photosynthesis than the XL62AA hybrid, but only a high leaf water potentials. Photosynthetic rates of both hybrids decreased as leaves aged. The LH hybrid maintained higher levels of soluble sugars and starch in the leaves as water potentials declined, perhaps owing to higher photosynthetic. The concentration of abscisic acid was also higher in the LH hybrid particularly when plants became water stressed. Comparisons of the internal water relations between the hybrids indicated that differences in the leaf turgor-leaf water potential relationship existed only during the time tassels were emerging. During this period, the LH hybrid maintained higher turgor pressures at all leaf water potentials compared with the XL62AA hybrid. When stress was imposed during the time of rapid leaf expansion and the mid-grain filling stages of development, the leaf turgor-leaf water potential relationships were similar in the two hybrids. The LH hybrid exhibited certain physiological characteristics that may allow greater drought tolerance or resistance when compared with a good drought tolerant commercial hybrid. As such, the LH hybrid may represent an important source of germplasm for developing more drought tolerant hybrids. (Murphy-IVI)
W84-03276

YIELD, WATER RELATIONS, GAS EXCHANGE, AND SURFACE REFLECTANCES OF NEAR-ISOGENIC WHEAT LINES DIFFERING IN GLAUCOUSNESS,
Agricultural Research Service, Logan, UT. Crops Research Lab.
D. A. Johnson, R. A. Richards, and N. C. Turner.
Crop Science, Vol. 23, No. 2, p 318-325, March-April, 1983. 4 Fig, 5 Tab, 21 Ref.

Descriptors: *Crop yield, *Plant water potential, *Reflectance, *Wheat, *Glaucous, Soil water potential, Water use efficiency, Epicuticular wax, Transpiration, Leaves, Drought resistance.

Near-isogenic lines that contrast in the presence or absence of glaucousness were developed in durum wheat (Triticum turgidum L. durum group) and common wheat (T. aestivum L.) and grown in plots in three field environments varying in soil water availability. The glaucous selections yielded significantly more grain and dry matter than non-glaucous selections in the two higher yielding environments but not in the very dry environment where average yield was 66 g/sq m. No differences within or between lines were found in soil water extraction patterns. Furthermore, leaf water potentials determined at predawn and midday exhibited no consistent differences between glaucous and non-glaucous selections. Lines selected for glaucousness varied in wax content of the different plant parts. Although differing in glaucousness, the glaucous selections did not necessarily exhibit greater amounts of epicuticular wax. Field gas exchange measurements for flag leaves and sheaths also indicated no beneficial or detrimental effects of glaucousness at saturating light and optimum temperature for photosynthesis. Surface reflectances in the 400 to 700 nm wavelengths were the same for the adaxial surface of the flag leaf, but were 8 to 15% higher in the glaucous than non-glaucous selections of one line for the ear, sheath, and abaxial flag leaf surface. Reflectances increased linearly with amount of epicuticular wax and were greater in the driest environment. The greater yield of the glaucous over the non-glaucous lines is discussed in relation to differences in reflectance and the possible influence of glaucousness on tissue temperature, leaf area duration, and other factors. (Author's abstract)
W84-03277

GENOTYPIC VARIATION FOR GLYCINEBETAINE ACCUMULATION BY CULTIVATED AND WILD BARLEY IN RELATION TO WATER STRESS,
Shell Development Co., Modesto, CA.
J. A. R. Ladyman, K. M. Ditz, R. Grumet, and A. D. Hanson.
Crop Science, Vol. 23, No. 3, p 465-468, May-June, 1983. 1 Fig, 4 Tab, 19 Ref. Dept. of Energy contract DE-AC02-76-ERO1338.

Descriptors: *Glycinebetaine, *Accumulation, *Cultivation, *Barley, *Water stress, Drought resistance, Betaine.

The accumulation of betaine (glycinebetaine, N,N,N-trimethylgly-cine) in barley (Hordeum vulgare L.) during water stress may be of adaptive value. The objective of this research was to evaluate the variability for betaine level among genotypes of H. vulgare and H. spontaneum C. Koch in preparation for a physiological-genetic assessment of the adaptive value of betaine accummulation. Betaine was determined using either a pyrolysis/gas chromatographic method or a periodide spectrophotometric assay, specially modified for screening. In controlled environment tests, 339 genotypes were grown to the four-leaf stage under well-watered conditions and analyzed for shoot betaine level; 145 of these were also tested under water-stressed conditions. There were significant differences for betaine level among genotypes, both without and with water stress (approximate ranges of betaine levels: 10 to 40 micromol/g dry wt in well-watered conditions; 35 to 90 micromol/g dry wt under stress). The betaine levels of stressed plants were significantly correlated with those of unstressed plants of the same genotype. Thirteen H. vulgare cultivars which were high and low accumulators in controlled environments were grown in the field under simulated dryland conditions and betaine was analyzed in the upper leaves. At the ear emergence stage, significant variation for betaine level was observed among cultivars although there were no significant differences in their water status. Those cultivars that accumulated either high or low levels of betaine in controlled environments accumulated respectively high or low levels in the field, the correlation among cultivars in the two environments was highly significant (r = 0.71). These results indicate that genotypic variability for betaine level is expressed in both controlled environmental and in the field, and that this variabiity is unlikely to be due solely to variability for water status. Physiological-genetic studies of the adaptive role of betaine may thus be possible. (Author's abstract)
W84-03278

IRRIGATION OF SOYBEAN GENOTYPES DURING REPRODUCTIVE ONTOGENY. I AGRONOMIC RESPONSES,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
L. L. Korte, J. H. Williams, J. E. Specht, and R. C. Sorensen.
Crop Science, Vol. 23, No. 3, p 521-527, May-June, 1983. 4 Fig, 1 Tab, 37 Ref. Nebr. Agric. Exp. Stn. projects 12-012 and 12-091.

Descriptors: *Irrigation, *Soybeans, Soil moisture, Water stress, Cultivars, Seed yield, Irrigation management, Irrigation effects.

Successful irrigation management for soybean 'Glycine max (L.) Merr.' requires a knowledge of the effect of irrigations applied during specific stages of reproductive ontogeny. Eight soybean cultivars, varying in stem growth habit and maturity, were subjected to a factorial set of eight irrigation treatments involving either no irrigation or one irrigation applied at three reproductive stages: R1 to R2 flowering (F), R3 to R5 pod elongation (P), or R5 to R6 seed enlargement (S). The experiment was conducted for 3 years on a Sharpsburg silty clay loam (Typic Argiudoll). An F irrigation had little effect on ultimate seed yield (+ 20 kg/ha) and for some cultivars actually depressed yield below that of the nonirrigated check. A P irrigation consistently increased seed yield (+379 kg/ha), irrespective of cultivar or year. An S irrigation also enchanced seed yield (+384 kg/ha), but the degree of enhancement was inconsistent across years, being influenced by the amount of natural rainfall occurring during the seed enlargement stage. Although a dual F-P irrigation treatment enhanced seed yield above that for both the nonirrigated check and single F irrigation treatment, the seed yield increase was significantly smaller (+16 kg/ha) than that achieved with a single P irrigation treatment. Soybean maturity was delayed 2 to 3 days with irrigation but the delay was greater when irrigation was applied late in reproductive ontogeny. This senescence delay lengthened the seed-fill period and was responsible in part for the seed yield enhancement effected by irrigation. Increases in soybean plant height and lodging were greatest with an F irrigation, intermediate with a P irrigation, and minimal with an S irrigation. Although irrigation effects on seed quality were variable depending on the cultivar, there was an overall tendency for a P irrigation to improve and an F irrigation to worsen seed quality. An F irrigation had no effect on seed quality. Of the eight cultivars evaluated, the determinate 'Elf' was the most yield responsive to irrigation and was relatively resistant to changes induced by irrigation in plant height, lodging, and seed quality. Based on these data, optimal yield enhancement in irrigated soybean culture can be achieved with the use of short stature or lodging-resistant cultivars irrigated during pod elongation (R3 to R4) and seed enlargement (R5 to R6).
W84-03279

IRRIGATION OF SOYBEAN GENOTYPES DURING REPRODUCTIVE ONTOGENY II. YIELD COMPONENT RESPONSES,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
L. L. Korte, J. E. Specht, J. H. Williams, and R. C. Sorensen.
Crop Science, Vol. 23, No. 3, p 528-533, May-June, 1983. 4 Fig, 1 Tab, 13 Ref. Nebr. Agric. Esp. Stn. projects 12-091 and 12-012.

Descriptors: *Irrigation, *Soybean yield, Phenology, Irrigation effects, Water stress, Soil moisture, Growth stage.

The magnitude of a seed yield increase that occurs when soybeans 'Glycine max. (L.) Merr.' are irrigated depends upon the phenologic timing of the irrigation in relation to the temporal sequence with which the components of seed yield are established and fixed. Eight soybean cultivars, varying in stem growth habit and maturity, were irrigated according to a factorial treatment design in which either no irrigation or one irrigation was applied at three reproductive stages: R1 to R2 flowering (F), R3 to R4 pod elongation (P), or R5 to R6 seed enlargement (S). An F irrigation increased the numbers of pods/plant (+2.8) and seeds/plant (+5.8), but an offsetting decrease occurred in 100-seed weight (-0.9 g), resulting in little change in seed yield. A P irrigation had no effect on 100-seed weight, but increased the numbers of pods/plant (+3.4) and seeds/plant (+7.9) resulting in a large increase in seed yield. An S irrigation resulted in only slight increases in the numbers of pods/plant (+1.0) and seeds/plant (+3.3), but greatly increased 100-seed weight (+1.4 g), again leading to a large seed yield increase. These observations suggested that irrigation early in reproudctive ontogeny greatly reduced flower and pod abortion, whereas irrigation later in ontogeny reduced ovule abortion within developing pods. The cultivar 'Harcor' possessed unusually high numbers of one-and two-seed pods, while 'Elf' had substantially fewer numbers of three-seed pods, and 'Woodworth' possessed larger numbers of four-seed pods. Irrigation timing differentially influenced the frequencies of the various pod classes relative to their contribution to the increase in total pods/plant, primarily because of effects on ovule abortion within developing pods. The effects of irrigation timing on number of seeds/plant and 100-seed weight were thus consistent with the effects on seed yield reported earlier. (Author's abstract)
W84-03280

ALFALFA RESPONSE TO SOIL WATER DEFICITS. I. GROWTH, FORAGE QUALITY, YIELD, WATER USE, AND WATER-USE EFFICIENCY,
Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics.
P. R. Carter, and C. C. Sheaffer.
Crop Science, Vol. 23, No. 4, p 669-675, July-August, 1983. 9 Fig, 3 Tab, 33 Ref. OWRT, USDI grant 14-34-0001-1236-B158 MINN.

Descriptors: *Alfalfa, *Soil water, *Plant growth, *Crop yield, *Water use, *Water use efficiency, Soil-water-plant relationships, Drought resistance, Irrigation effects, Evapotranspiration, Soil moisture deficiency, Leaves.

Although many researchers have reported yield increases due to alfalfa irrigation when soil water has been limited, little information is available on alfalfa plant and soil water relationships which might be used to improve water management strategies. Our objective was to determine effects of plant water deficits on alfalfa seasonal growth patterns, forage quality, forage yield, water use, and water-use efficiency. During 1981, established alfalfa grown on a sandy soil was subjected to four water supply levels designated: high irrigation (H), medium high irrigation (MH), medium low irrigation (ML), and unirrigated, rainfall only (U). Soil water depletions occurred for all treatments to at least 1.9 m. Alfalfa midday plant water potentials (psi mp) in H and MH treatments ranged from -0.7 to -1.3 MPa throughout the season. For alfalfa subjected to ML and U treatments, psi mp reached -2.7 and -4.0 MPa, respectively. Dry weight (DW) accumulations for alfalfa in H and MH treatments increased with successive harvests during the summer while harvest DW for alfalfa in ML and U treatments declined. Relative growth rate (RGR) declined sharply as psi mp decreased. At moderate plant water stress (psi mp of -1.5 to -2.0 MPa), little growth occurred and under severe water stress, (psi mp of -1.5 to -2.0 MPa), little growth occurred and under severe water stress, (psi mp < -2.5 MPa), RGR were negative due to leaf loss. Reduced soil water availability resulted in increased leaf stem weight ratios and in vitro dry matter disapperance (IVDMD), but only under severe and long-term plant water stress. Crude protein (CP) concentration was unaffected by plant water status. It appeared that irrigation water could be used efficiently on coarse-textured soils by moderate water application to alfalfa at 50% depletion of extractable soil water, an apparent threshold for maintenance of favorable plant water status. A close associations between forage yield of individual harvests and cumulative psi mp indicates potential for initiation of irrigations when plant measurements indicate soil water depletions to a threshold level. (Author's abstract)
W84-03281

ALFALFA RESPONSE TO SOIL WATER DEFICITS. II. PLANT WATER POTENTIAL, LEAF CONDUCTANCE, AND CANOPY TEMPERATURE RELATIONSHIPS,
Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics.
For primary bibliographic entry see Field 2D.
W84-03282

ALFALFA RESPONSE TO SOIL WATER DEFICITS. III. NODULATION AND N2 FIXATION,
Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics.
P. R. Carter, and C. C. Sheaffer.
Crop Science, Vol. 23, No. 5, p 985-990, September-October, 1983. 7 Fig, 2 Tab, 19 Ref.

Descriptors: *Alfalfa, *Soil moisture deficit, *Nitrogen fixation, Soil-water-plant relationships, Irrigation effects, Plant water potential, Soil water potential.

Harvesting of forage legumes removes the photosynthate source necessary of remaintaining N2 fixation and nodule development. Water stress also depresses legume N2 fixation. In a field study on Typic Hapludoll (silt loam) soil, nitrogenase specific activity (NSA), nodule numbers, and shoot and root growth of irrigated and nonirrigated alfalfa were measured during a harvest/regrowth cycle. In a glasshouse study with Udorthentic Haploboroll (loamy sand) soil, NSA, nodulation, shoot and root growth, and root total nonstructural carbohydrate (TNC) concentration of nonharvested and harvested alfalfa were monitored during two successive harvest/regrowth cycles. Both harvest treatments were subjected to a range of soil and plant water deficits. Forage harvest decreased NSA and root TNC concentration for well-watered alfalfa, but changes in NSA for water-stressed plants were more associated with fluctuations in plant water (psi p) and soil matric (psi m) potentials than to removal of herbage or level of root carbohydrates. Nitrogenase specific activity declined linearly as psi p decreased to -3.0 PMa, at which point activity approached zero. Alfalfa nodules subjected to severe water stress were able to resume activity when soil moisture levels were restored. Nodulation was inhibited by well-watered conditions (mean psi m of -0.015 MPa) in the silt loam and by soil water deficits (mean psi m of -0.07 to -0.51 MPa) in the loamy sand. (Murphy-IVI)
W84-03283

ROLE OF PANICLE EXSERTION IN WATER STRESS INDUCED STERILITY,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
J. C. O'Toole, and O. S. Namuco.
Crop Science, Vol. 23, No. 6 , p 1093-1097, November-December, 1983. 3 Fig, 1 Tab, 22 Ref.

Descriptors: *Panicle, *Exsertion, *Water stress, *Sterility, Rice, Plant water Potential, Sprinkler irrigation, Leaves, Rproductivity, Evapotranspiration.

Although the sensitivity of crop species to water stress during reproductive growth stages is well documented, the causes of sterility are not understood. Rice cultivar IR36 was grown on a deep silty loam soil under full sprinkler irrigation for 77 days. A line source sprinkler system was then utilized during panicle exsertion and flowering to impose six continuously decreasing irrigation treatments. After the 15-day treatment period, full sprinkler irrigation was resumed until maturity. Soil moisture extraction and plant water potential were monitored as soil and plant water stress progressed. Panicle exsertion rate was measured on tagged panicles which were later used to assess percent final panicle exsertion and percent sterility. The six irrigation treatments varied in grain yield from 5.0 t/ha to about 1 t/ha with corresponding increases in spikelet sterility of 16.6 and 74.2%. Panicle exsertion rate decreased linearly with decreasing mean daily leaf water potential. The degree of final panicle exsertion from the flagleaf sheath and percent spikelet sterility both decreased linearly with panicle exsertion rate. All spikelets left unexserted from the flagleaf sheath were sterile. Panicle exsertion rate was slightly confounded by tiller age in that late tillers in the well irrigated treatment had a slower exsertion rate and higher percent sterility than earlier tillers. The early tillers which exserted at rates of 4.5 to 5.5 cm/day under well watered conditions decreased to about 3.0 cm/day in the stressed plot and accounted fo 25 to 30% spikelet sterility in the severely stressed treatment. (Murphy-IVI)
W84-03284

SIGNIFICANCE OF ACCELERATED LEAF SENESCENCE AT LOW WATER POTENTIALS FOR WATER LOSS AND GRAIN YIELD IN MAIZE,
Navarra Univ., Pamplona (Spain). Dept. Fisiologia Vegetal.
P. M. Aparicio-Tejo, and J. S. Boyer.
Crop Science, Vol. 23, No. 6, p 1198-1202, November-December, 1983. 7 Fig, 19 Ref. NSF grant PCM 79-09790.

Descriptors: *Leaves, *Water potentials, *Senescence, *Water loss, *Maize yield, Transpiration, Stomatal transpiration, Dry matter, Water conservation.

Productivity is lost when plants are subjected to dry soil conditions and this loss is often accompanied by the senescence of leaf tissue. The role of leaf senescence in water conservation and grain production was therefore evaluated in maize (Zea mays L.) subjected to low water potentials for most of the grain filling period. The plants were grown in soil in controlled environment chambers and water was withheld from the soil after pollination had occurred. Low leaf water potentials were maintained for 30 days (until the grain matured) by daily addition of small amounts of water to the soil. The low water potentials (-1.8 to -2.0 MPa) inhibited dry matter accumulation and transpiration by the plants. However, in addition to the initial inhibition of transpiration by stomatal closure, there was a further inhibition (about 11% of the control rate) associated with accelerated senescence of the leaves. Excision of senesced leaf tissue showed that, despite this inhibition of water loss attributable to senescence, the dead tissue itself continued to lose a small amount of water while attached to the plants. Although the low water potentials were of long enough duration to allow significant acclimation of the plants, the senescing tissue contributed only a small amount of dry matter to the grain by mobilizing leaf constituents. Since the amount of water conserved by the senescing tissue was also small, it is likely that accelerated leaf senescence contributes little to grain production at low water potentials and has the disadvantage that it sacrifices potential photosynthetic surface. Therefore, selection against accelerated senescence of leaves at low water potentials may be desirable for crops. (Author's abstract)
W84-03285

CROP-CLIMATE MODELING USING SPATIAL PATTERNS OF YIELD AND CLIMATE. PART 1: BACKGROUND AND AN EXAMPLE FROM AUSTRALIA,
University of East Anglia, Norwich (England). Climatic Research Unit.
T. M. L. Wigley, and T. Qipu.
Journal of Climate and Applied Meteorology, Vol. 22, No. 11, p 1831-1841, November, 1983. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Crop yield, *Climates, *Australia, Wheat, Model studies, Spatial distribution, Statistical models, Multivariate regression analysis.

Crop yield is certainly dependent on the weather conditions prevailing during, and sometimes prior to the growing season, expressing this dependence in terms of a reliable quantitative relationship, a crop-climate model, is a difficult task. The direct linking of spatial patterns of crop yield and spatial patterns of climate is a new statistical crop-climate analysis technique. Yield and climate data from networks of crop reporting districts and meteorological stations are decomposed into orthogonal components using principal components analysis. A function of the climate components is then used to express each yield component using multiple regression. The combining of these regression equations gives an equation which relates interannual variations in the spatial patterns of yield to interannual variations in the spatial patterns of selected climate variables. Wheat yield data from 59 crop reporting districts in southwestern Australia from the period 1929-1975 are used to illustrate the method. The climate contribution is shown to be highly significant, with winter precipitation being the most important variable. A single equation relating yield and climate patterns correctly reproduces the differing results obtained for separate parts of the study area by earlier workers. The influence of winter and autumn precipitation is nonlinear and the study divides therefore into three zones: a high rainfall area where rainfall is generally more than optimum so that lower rainfall gives higher yields; a low rainfall area where rainfall is less than optimum so that positive rainfall anomalies are associated with higher yields; and an intermediate zone where average rainfall is close to optimum so that anomalies in either direction suppress yields. No evidence was found for any significant change in the sensitivity of wheat yields to climate in spite of a complete change in the variety of wheat cultivated. (Baker-IVI)
W84-03302

WATER USE BY ALFALFA, MAIZE, AND BARLEY AS INFLUENCED BY AVAILABLE SOIL WATER,
New Mexico State Univ., Las Cruces. Dept. of Crop and Soil Sciences.
A. S. Abdul-Jabbar, T. W. Sammis, D. G. Lugg, C. E. Kallsen, and D. Smeal.
Agricultural Water Management, Vol. 6,. No. 4, p 351-363, 1983. 5 Fig, 2 Tab, 29 Ref. OWRT projects A-063 N.Mex., B-069 N.Mex., and C-90229.

Descriptors: *Alfalfa, *Corn, *Barley, *Water use, *Soil water, Evapotranspiration, Available water, Sprinkler irrigation, Soil types.

The availability of soil water is one of the most important determinants of crop production. Field studies were conducted to examine the relationships between relative evapotranspiration (E/E sub max) and available water (W) for alfalfa, maize, and barley. Line source sprinkler irrigation systems were used to provide the variations in soil moisture. Actual evapotranspiration (E) was determined using the water balance method. Maximum evapotranspiration (E sub max) was the highest E observed among all irrigation levels. Potential evapotranspiration (E sub 0) was estimated using Penman's equation to characterize the evaporative demand. The results show that the relationships between E/E sub max and W were different for the three crops. For alfalfa, the relationship was dependent on the physical properties of the soil and on E sub 0. In a clay loam soil, the declines in E from E sub max commenced at a higher value of W than in a sandy loam soil. Furthermore, the rate of decline in E from E sub max was dependent on E sub 0 and was greater as E sub 0 increased. In the sandy loam soil, the relationship between E/E sub max and W was not dependent on E sub 0. For maize and barley in clay loam soils, E/E sub max as a function of W was linear, and was not dependent on E sub o. This study was compared to results reported in the literature, and it was hypothesized that differences were related mainly to the way variation in soil moisture was introduced over the measurement period. (Author's abstract)
W84-03444

WHEAT ROOT GROWTH, GRAIN YIELD AND WATER UPTAKE AS INFLUENCED BY SOIL WATER REGIME AND DEPTH OF NITROGEN PLACEMENT IN A LOAMY SAND SOIL,
Indian Grassland and Fodder Research Inst., Jhansi.
B. R. Sharma, and T. N. Chaudhary.
Agricultural Water Management, Vol. 6, No. 4, p 365-373, 1983. 3 Fig, 3 Tab, 16 Ref.

Descriptors: *Crop yield, *Wheat, *Soil water, *Growth, *Nitrogen, Irrigation effects, Water table, Water uptake, Roots, Water use.

Root growth, grain yield and water uptake by wheat in relation to soil water regime and depth of nitrogen (N) placement were studied in metallic cylinders filled with loamy sand soil. Root-length and -weight densities were greater under irrigated than under un-irrigated conditions and they increased with deep placement as compared to surface mixing of fertilizer N. The differences were relatively larger in the deeper than in the upper soil layers and increased during later stages of plant growth. Under non-irrigated conditions, constant water table at 100 cm depth produced maximum root growth in the top 30 cm soil. Water uptake rate increased with increase in root density depending on root age and soil water status. Dry matter accumulation at different stages of plant growth and grain yield varied significantly with moisture regime and depth of N placement. Deep placement of fertilizer N under shallow water table and non-irrigated conditions caused greater root growth, better water utilization and a higher production. (Author's abstract)
W84-03445

2J. Erosion and Sedimentation

THE BEHAVIOUR OF SILT-LADEN CURRENT,
Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
W. H. Graf.
International Water Power and Dam Construction, Vol. 35, No. 9, p 33-37, September, 1983. 9 Fig, 11 Ref.

Descriptors: *Sedimentation, *Reservoirs, Density currents, Gravity currents, Turbidity currents, Stratification, Stagnant water, Turbidity, Sediment transport, Silt.

Density currents are considered as they are encountered when sediment-laden river flow enters an almost stagnant water body, such as a reservoir or lake. Density currents have features in common with open-channel flows, but differ essentially because the buoyancy of the surrounding fluid reduces the gravity force by a normalized density difference. Gravity will inhibit the deep layer from mixing with the density current along the slope. Density currents may deposit sediments from the current onto the bed, erode sediments from the bed and carry them with the current, or may be steady state currents where an equilibrium between bed erosion and deposition exists. Proper knowledge of density current implications will aid in the determination of the loss of storage capacity as a result of settling out of suspended matter; the proper installation and operation of the opening gates which might well conserve a part of the storage capacity normally destroyed by deposition; the prediction and management of the lake's water quality (turbidity); the proper handling and use of density currents to empty out already accumulated sediment; and the avoidance of wear on hydraul machinery and duct linings. (Baker-IVI)
W84-02994

MODEL OF ADAPTATION OF ACTIVE-SIL ECOSYSTEM TO MULTICOMPONENT PO LUTION,
Akademiya Nauk SSSR, Moscow. Inst. Vodnyk Problem.
V. A. Vavilin, and V. B. Vasil'ev.
Doklady Biological Sciences, Vol. 267, No. 1-6, 554-558, November-December, 1982. 4 Fig, 4 Re Translated from Doklady Akademii Nauk SSS Vol. 267, No. 4, p 1012-1016, December, 198

Descriptors: *Model studies, *Ecosystems, *Si Mathematical studies, Biomass, Oxidation, Su strates.

A generalized model of the process of aerob biological purification is based on the assertion th the composition of microorganisms in reactors pe forming the purification process depends upon t range of the processed pollutants. The latter determined not only by the type of waste wate but also depends on the conditions of reactor ope ation. A system is examined with active silt, repr senting an ideal reactor-elutor in which polluta oxidation and biomass accumulation occur, and settling tank in which the biomass is compact and then returned to the reactor-aeration tank. T model demonstrated that to each magnitude of s stress there corresponds a specific species compo tion of the active-silt microflora. The fraction species oxidizing those difficult to oxidize polluta components increases with a decline in silt stre The purification effect increases when a multista purification is used, where the microorganism sp cies composition is formed at each stage. (Bak IVI)
W84-03026

DECOMPOSITION OF ORGANIC MATTER LAKE SEDIMENTS,
Agricultural Research Service, Durant, O Water Quality and Watershed Research Lab.
Y. Avnlmelech, J. R. McHenry, and J. D. Ross.
Environmental Science and Technology, Vol. No. 1, p 5-11, January, 1984. 4 Fig, 4 Tab, 28 R

Descriptors: *Lake sediments, *Decomposing ganic matter, *Lake sediments, Deposition, Est aries, Reservoirs, Mathematical models, Carbo Nitrogen, Phosphorus, Depth, Diagenesis.

With the use of mathematical calculations the creases with depth of organic carbon, nitrog and total phosphorus in sediments from 64 lak reservoirs, and estuaries across the United St were in agreement with a first-order kinetic mod The average rate coefficients for C, N, and P w 24/1000, 21/1000, and 5/1000 per year, respecti ly. The corresponding modes of the rate coe cients were 4/1000, 5/1000, and 4/1000 per ye respectively, for C, N, and P. The constants for and N are closely related and reflect the microb decomposition of these components. The P dec coefficient is probably related to the decompo tion of organic P and subsequent upward P dif sion. The decay coefficients would be used a general first approximation to the rates of orga matter diagenesis in sediments. (Murphy-IVI)
W84-03032

SOIL EROSION IN THE PALOUSE: AERIAL PERSPECTIVE,
Agricultural Research Service, Pullman, WA.
B. E. Frazier, D. K. McCool, and C. F. Engle.
Journal of Soil and Water Conservation, Vol. No. 2, p 70-74, March-April, 1983. 10 Fig, 11 R

Descriptors: *Aerial photography, *Erosion, E sion control, Monitoring, Data acquisition, louse.

Aerial photography is an effective tool for stu ing soil erosion and determining the success failure of management practices to control it. many cases spatial relationships between culti

on and erosion patterns can only be viewed from ove ground as only a portion of any slope is sible from the ground. The significance that can extracted from photographs of rill patterns de- nds on the factors involved in the formation of ls. Basic rill patterns develop on slopes that are eded across the slope into soil pulverized by mmer fallow and where all runoff originates thin the rilled area. These rill patterns are simple ndritic on concave slopes, parallel on straight pes, and divergent on convex slopes. Other eas offer no photographable patterns such as oded ridge crests, isolated and eroded knobs, and oad, concave alluvial lands. (Baker-IVI)
84-03052

OIL EROSION ON SUBARCTIC FOREST LOPES,
ydrocon, Inc., Fairbanks, AK.
W. Aldrich, and C. W. Slaughter.
urnal of Soil and Water Conservation, p 115-118, arch-April, 1983. 6 Fig, 5 Tab, 18 Ref.

escriptors: *Soil erosion, *Subarctic zone, Forest soils, *Slopes, Soil stability, Rill erosion, heet erosion, Logging, Clear cutting, Runoff, egetation, Mathematical models.

he universal soil loss equations is applied to a udy site on the Caribou-Poker Creeks Research Vatershed (Alaska) in order to assess the suitabil- y of the equation for predicting sheet-rill erosion Alaska's interior. When a permafrost-free su- rctic setting is stripped of all vegetation from the il surface, an increase in rainfall erosion is 16 nes that produced from an undisturbed forest. he rate difference is from 0.008 ton per acre per ear to 0.13 ton per acre per year. Removing the ees from a forested area, with only minor disturb- ace of ground cover, did not increase erosion. A ehicle trail on permafrost terrain had a very low rosion rate of 0.03 ton per acre per year. Compar- on of measured erosion with erosion predicted by he universal soil loss equation indicated that the quation overestimated annual rainfall erosion by n average of 21% and overestimated individual orm erosion by an average of 174%. The stand- rd deviation of the mathematical model was 28%. (Murphy-IVI)
84-03056

OIL AND NUTRIENT RUNOFF LOSSES VITH IN-ROW, CHISEL-PLANTED SOY- EANS,
gricultural Research Service, Watkinsville, GA.
. W. Langdale, H. F. Perkins, A. P. Barnett, J. C. eardon, and R. L. Wilson, Jr.
ournal of Soil and Water Conservation, p 297-301, lay-June, 1983. 1 Fig, 5 Tab, 20 Ref.

escriptors: *Soil erosion, *Nutrients, *Runoff, Soybeans, *Conservation tillage, Agricultural unoff, Crop residues, Nutrient losses, Mulches, ye.

Coulter, in-row chiseling 20 centimeters deep in ye stubble effectively controlled runoff (less than r equal to 13%) on rainulator plots (10.7- and 1.4-meter slope lengths) with a 7% slope until vater content in the topsoil approached 14.2% about 0.1-bar suction). In-row chiseling and soil over collectively reduced soil losses during rainu- ator runs to less than 0.5 metric ton per hectare on oth slope lengths. Increased slope length led to ncreased runoff, event with low soil water content luring soybean canopy development. Removing rop residue and destroying the chisel slot with omplete tillage caused soil losses exceeding 40 netric tons per hectare. Runoff-weighted nutrient osses related positively to soil losses. Increased lope length consistently increased nutrient losses luring all tillage-soil cover sequences. Most nutri- nt loss variation was accounted for by treating oil loss as an independent variable during the rye nulch cover period. Phosphorus losses were corre- ated better to soil losses among tillage-soil cover equences than to the cations. Coulter, in-row, chisel-planted soybeans through rye residues fol- owing winter-spring cattle grazing of rye effec- ively controlled runoff as well as soil loss and ome nutrient losses. (Murphy-IVI)
W84-03062

SOIL EROSION FROM FIVE SOYBEAN TILL- AGE SYSTEMS,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
C. H. Shelton, F. D. Tompkins, and D. D. Tyler.
Journal of Soil and Water Conservation, p 425-428, September-October, 1983. 8 Tab, 6 Ref.

Descriptors: *Soil erosion, *Soybeans, *Tillage, Runoff, Rainfall, Simulation, Soil types, Loess, Agricultural runoff.

Runoff from natural and simulated rainfall on 0.25 acre plots caused significant soil losses from soybean plots and five different tillage systems on a highly erodable soil in West Tennessee. Soil losses generally were greatest for the conventional-till, single-crop soybean system, followed in order by drilled soybeans; conventional-till, double-cropped soybeans; no-till, double-cropped soybeans; and no-till, single-cropped soybeans. Weed control was attained without the use of herbicides. Because each of the five systems has advantages and disadvantages, a program of rotating alternate strips of a no-till system with a conventional-till, double cropped system would have merit. To control erosion and accompanying loss of nutrients, however, each system should provide soil cover when high-energy rainfall is most likely to occur. (Murphy-IVI)
W84-03066

OBSERVATION OF EPISODIC SEDIMENTA- TION IN A TIDAL INLET (SABINE PASS, TEXAS AND LOUISIANA),
Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 2L.
W84-03107

PROBABILITY SAMPLING TECHNIQUES FOR ESTIMATING SOIL EROSION,
Utrecht Rijkuniversitet (Netherlands). Dept. of Physical Geography.
J. M. Roels, and P. J. Jonker.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1224-1228, November/December, 1983. 5 Fig, 4 Tab, 11 Ref.

Descriptors: *Soil erosion, *Sampling, *Probability, Rill erosion, Interrill erosion, Soil loss, Ardeche drainage basin, France.

Soil erosion in a particular area can be estimated from measurements at sites which are thought to be representative of the entire area. Modified Gerlach troughs were used to measure both rill and interrill erosion in the rangelands of the Ardeche drainage basin in France. Random, systematic, stratified random, and cluster sampling methods were tested for various numbers of plots and plot widths in order to find the method that gives the most accurate estimate of soil loss. If both the rill and interrill subpopulations are sampled, random sampling and stratified random sampling give almost identical standard errors. Cluster sampling yields large errors and is therefore less effective. Systematic sampling, however, allows one to choose more accurate samples of an economical size, but its efficacy depends largely on the number of rills in the study area. The smallest standard errors are obtained by measuring the total rill erosion and by sampling only the interrill subpopulation. When this procedure is applied, the four sampling methods turn out to be equally accurate. The size and number of erosion plots to be used in soil loss measurements in a study area depend on the purpose of the experiments. Only for a rapid reconnaissance of the extent of soil erosion are data with low or unknown accuracy acceptable. Probability sampling techniques allow the accuracy of the plot data to be determined. (Moore-IVI)
W84-03184

RAINFALL EROSION INDICES FOR CANADA EAST OF THE ROCKY MOUNTAINS,
Department of Agriculture, Guelph (Ontario).
G. J. Wall, W. T. Dickinson, and J. Greuel.
Canadian Journal of Soil Science, Vol. 63, No. 2, p 271-280, May, 1983. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Rainfall index, *Erosion, Canada, Rocky Mountains, Mountains, Soil loss, Mathematical equations.

Relatively simple techniques for estimating average annual rainfall erosion indices and seasonal distribution patterns of rainfall erosion yield values comparable to those determined by more tedious methods in the United States. These techniques have proven to be extremely useful for the development of a first approximation of rainfall erosion indices for Canadian locations east of the Rocky Mountains. There is a significant range of rainfall erosion index values across the country. There are definite regional patterns for both the annual index and the monthly distributions. The data base of climatic stations used in this study has proven to be large enough to yield realistic broad patterns for a large portion of Canada. (Baker-IVI)
W84-03225

ESTIMATES OF SOIL EROSION AND DEPO- SITION FOR SOME SASKATCHEWAN SOILS,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
E. De Jong, C. B. M. Begg, and R. G. Kachanoski.
Canadian Journal of Soil Science, Vol. 63, No. 3, p 607-617, August, 1983. 2 Fig, 6 Tab, 22 Ref.

Descriptors: *Erosion, *Estimating, Saskatchewan, Soil loss, Water erosion, Wind erosion, Universal soil loss equation, Mathematical equations.

Traditional cultivation practices involving large tracts of land in summerfallow have encouraged wind and water erosion on the Prairies and have reduced soil fertility. Actual measurement of soil loss by erosion can be obtained from field plots maintained over many years. Cs-137 from the atmospheric testing of nuclear devices in the 1950s and 1960s was used to estimate soil erosion in eight small basins in hummocky topography. Three basins had not been cultivated since 1950 and in these Cs-137 showed little or no separation according to landscape position. In the cultivated basins Cs-137 varied significantly with slope position and could be used to identify areas of soil loss and deposition. The Cs-137 distribution in the cultivated basins indicates the simultaneous occurrence of erosion on the upper slope and deposition on the lower slope areas. Therefore the universal soil loss equation (USLE) is difficult to apply on this topography. The Cs-137 data could be used to estimate rates of soil loss or deposition at specific slope positions. The results of the Cs-137 balances did correctly separate basins in which wind erosion was known to be important, from basins where water erosion was probably the dominant process of soil movement. (Baker-IVI)
W84-03228

SOIL EROSION AND PRODUCTIVITY, A RA- TIONAL LOOK AT A COMPLEX SITUATION,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
W. E. Larson, F. J. Pierce, and R. H. Dowdy.
Crops and Soil Magazine, Vol. 35, No. 9, p 19-20, August-September, 1983. 2 Fig.

Descriptors: *Soil erosion, *Crop yield, Acidity, Universal Soil Loss Equation, Corn Belt, United States, Erosion, Topsoil, Subsoil.

Various factors influence the productivity of a crop. Among these are the nature of the soil, the weather, the plant variety, such external sources as lime and fertilizer, and the management of all of these resources. The way a soil erodes and where it goes can both affect soil productivity. If the soil in leaving takes seedling plants with it, there will be an obvious decrease in crop production that year. If it leaves large gullies behind that cannot be farmed in the future, then the future yield is also affected. Soil eroding from a hillside and being deposited on a low spot on a field can either be detrimental or beneficial to productivity, depending on the landscape. Loss in productivity is thought to be greatest on slopes exceeding 6% and when subsoil properties are unfavorable for crop growth. About 29% of the cropland in the United

States is on slopes steeper than 6%. On generally fertile and deep soils of the Corn Belt, potential productivity will probably decline less than 10% in the next 50 years. (Baker-IVI)
W84-03231

RELATIONSHIP OF RUNOFF AND SOIL LOSS TO GROUND COVER OF NATIVE AND RECLAIMED GRAZING LAND,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2E.
W84-03256

SEDIMENT SAMPLING IN DIFFERENT AQUATIC ENVIRONMENTS: STATISTICAL ASPECTS,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 5A.
W84-03411

A DYNAMIC MODEL OF BASIN SEDIMENT YIELD,
Institute of Hydrology, Wallingford (England).
R. J. Moore.
Water Resources Research, Vol. 20, No. 1, p 89-103, January, 1984. 34 Ref.

Descriptors: *Sediment yield, *Sediment transport, *River basins, *Mathematical models, Suspended sediments, Storm runoff, Floods.

A model of basin sediment yield was developed on the basis of continuous time functions which are twice-differentiated in the parameter space, thereby avoiding the function minimization problems encountered when calibrating models that employ threshold elements. The model predicts the hour-to-hour variation in basin suspended sediment yield, incorporating the phenomenon that yields are influenced by the availability of sediment, as well as the capacity of flow to transport sediment. This is achieved through the definition of three model functions: an availability function; a removal function; and a translation function. The inverse Gaussian probability density function is introduced as a suitable translation function because of its shape and its physical interpretation in terms of Saint Venant equations of open channel flow, the equations of groundwater flow, and the general convection-diffusion equation. A censored objective function is employed to facilitate efficient model calibration in circumstances where significant sediment yields are produced by infrequently occurring flood events, but the changing availability of sediment between storm events demands that the model be run continuously over time. Adoption of a modeling strategy based on the use of smooth but physically plausible functions was an important concern and motivation in developing the new model. The performance of basin sediment yield models must be severely limited on account of the complexity of the sediment yield process at the basin scale and the paucity of data usually available. This lack of definition at the basin scale provides a persuasive argument in favor of simple models which represents the dominant modes of behavior of the system. (Moore-IVI)
W84-03415

ANALYTICAL SOLUTIONS OF KINEMATIC EQUATIONS FOR EROSION ON A PLANE. II. RAINFALL OF FINITE DURATION,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh.
Advances in Water Resources, Vol. 6, No. 2, p 88-95, June, 1983. 15 Fig, 6 Ref. NSF project ENG. 79-23345.

Descriptors: *Rainfall, *Mathematical equations, *Erosion, Erosion control, Kinematics, Water flow, Sedimentation.

Analytical solutions are derived to kinematic equations for erosion from a sloping plane subject to rainfall of finite duration. Both equilibrium and partial equilibrium cases are distinguished. Complete solutions of these cases have not appeared previously in hydrologic literature. Properties of these solutions are briefly discussed. A procedure is suggested for estimating the parameters contained in these solutions. (Baker-IVI)
W84-03462

BED LOAD FORMULAE FOR ALLUVIAL CHANNELS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Advances in Water Resources, Vol. 6, No. 2, p 112-120, June, 1983. 18 Fig, 14 Ref.

Descriptors: *Alluvial channels, *Bed load, Sediment load, Channels, Sedimentation, Slopes, Mathematical equations, Kalinske's equation.

Because of the complexity and random nature of the problem of deposition and scour, the approaches to the study of these problems are empirical, or semi-empirical at best. Among the popular bed load formulae, Kalinske's equation gave the best correlation with the experimentally determined sediment discharge. The values of the energy slope, calculated by the resistance equations, are in reasonable conformity with the experimental values. A relatively better agreement was found for the starvation case than for sedimentation. The procedure which combines the bed load formulae and resistance equation produced reliable results for the conditions tested, and therefore, is recommended for practical application under the same conditions. (Baker-IVI)
W84-03464

FLOCCULENT SETTLING IN QUIESCENT SYSTEMS,
Geraghty and Miller, Inc., Baton Rouge, LA.
For primary bibliographic entry see Field 5D.
W84-03475

2K. Chemical Processes

NITROGEN FIXATION AND PHOSPHORUS TURNOVER IN A HYPERTROPHIC PRAIRIE LAKE,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2H.
W84-03015

HYDROLOGIC CONTROL OF LAKE SUSCEPTIBILITY TO ACIDIFICATION,
Wisconsin Dept. of Natural Resources, Rhinelander.
J. M. Eilers, G. E. Glass, K. E. Webster, and J. A. Rogalla.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 1896-1904, November, 1983. 3 Fig, 4 Tab, 46 Ref. EPA grant CR 809484.

Descriptors: *Acidification, *Hydrology, *Wisconsin, *Lakes, Surface runoff, Groundwater, Precipitation, Acidity, Chemistry of precipitation, Cluster analysis, Alkalinity, Inlets, Outlets.

Two hundred and seventy-five lakes were sampled in the summer of 1979 to assess the factors controlling susceptibility of northcentral Wisconsin lakes to acidification. In addition to direct evaluation of means and ranges of the physical and chemical characteristics, a cluster analysis was carried out using alkalinity, color, and chlorophyll a data. Three well-defined clusters emerged that appeared to be controlled by hydrology; A - dominated by surface runoff; B - dominated by groundwater; C - dominated by precipitation. Lake water quality and susceptibility are influenced by morphometric, hydrologic and terrigenous factors in 18 watersheds analyzed. Hydrologic factors were most important in differentiating the low alkalinity and high alkalinity lakes. The potentially sensitive low alkalinity lakes in northcentral Wisconsin lack surface inlets or outlets and their chemistry is closely associated with precipitation chemistry. (Murphy-IVI)
W84-03017

FLUORIDE IN THE GROUND WATER OF NORTHEASTERN OHIO,
Akron Univ., OH. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W84-03073

THE GEOCHEMISTRY OF IRON AND MANGANESE IN THE WATERS AND SEDIMENTS OF BOLSTADFJORD, S. W. NORWAY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
J. H. Taylor, and N. B. Price.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 1, p 1-19, July, 1983. 6 Fig, 3 Tab, 53 Ref.

Descriptors: *Geochemistry, *Iron, *Manganese, *Sediments, *Bolstadfjord, *Norway, Interstitial water, Coastal waters, Physiochemical properties, Eddies, Fate of pollutants.

The near-surface circulation of Bolstadfjord is runoff dominated, while the deep waters are greatly restricted by the presence of shallow sills. The distribution of suspended particulate matter is closely allied to the general circulation, with the highest concentrations in the freshwater surface outflow. Elevated concentrations of dissolved and suspended particulate Fe and Mn are associated with restricted deep waters as a result of redox reactions and with river discharge. The basin sediments are anoxic throughout but because of the greatly restricted circulation, remobilized Fe and Mn appear to remain predominantly trapped within the fjord. Differentiation of Fe and Mn occurs to the extent that Fe sulfide precipitation is ubiquitous in the sediments whereas the entrapment of Mn, probably through Mn carbonate precipitation, is found only in the sediments of the more seaward basin (maximum Mn content of 1.5% by weight). The main controlling factors are probably a gradual build-up of Mn in the system and an increasing vertical eddy diffusion coefficient with depth. (Murphy-IVI)
W84-03135

CARBON DIOXIDE EMISSION AND CARBON ACCUMULATION IN COASTAL WETLANDS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W84-03136

INVESTIGATIONS ON HEAVY METAL SPECIATION IN NATURAL WATERS BY VOLTAMMETRIC PROCEDURES,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
For primary bibliographic entry see Field 5B.
W84-03185

MATERIAL BALANCE OF AQUATIC ECOSYSTEMS AND CHEMICAL BINDING (VOM STOFFHAUSHALT AQUATISCHER OKOSYSTEME ZUR FRAGE NACH DER CHEMISCHEN BINDUNG),
Neuchatel Univ. (Switzerland). Inst. de Chemie.
P. Baccini.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 316, No. 6, p 575-581, November, 1983. 14 Fig, 11 Ref.

Descriptors: *Ecosystems, *Copper, *Phosphorus, *Chemical binding, Iron hydroxide, Hypolimnion, Boundary conditions, Sediments, Organic matter, Nutrients, Bioavailability.

A system-analytical investigation of ecosystems elucidates those physical-chemical and biochemical processes which are relevant for the whole system. The system's balance of element and compound fluxes reflects the capacity of the 'biological program' to retain different chemical species for a longer or shorter time. This capacity is illustrated with copper(II) aqua ions and orthophosphate ions in an aquatic system. For phosphorus, a limiting nutrient in a lake, the biological subsystem 'sediment boundary layer' plays a crucial role. Within

this boundary layer an iron(III) hydroxide barrier reduces the phosphorus reflux into the hypolimnion. In the case of copper, an essential element having a toxic concentration in a purely inorganic form, natural dissolved organic matter reduces its bioavailability due to the formation of organic copper complexes. These dissolved forms of copper are exported more quickly. For both nutrients there is still a lack of data on the kinetics and the chemical nature of the chemical binding in the first (Cu) and the second sphere of coordination (P) with respect to the boundary conditions found in aquatic ecosystems. (Author's abstract)
W84-03186

CARBONATE MINERALOGY OF LAKE SEDIMENTS AND SURROUNDING SOILS I. BLACKSTRAP LAKE,
Saskatchewan Univ., Saskatoon. Dept. of Soil Science.
K. Ghebre-Egziabhier, and R. J. St. Arnaud.
Canadian Journal of Soil Science, Vol. 63, No. 2, p 245-257, May, 1983. 5 Fig, 4 Tab, 28 Ref. NSERC Grant No. A1446.

Descriptors: *Lake sediments, *Mineralogy, Lakes, Blackstrap Lake, Saskatchewan, Canada, Carbonates, Minerals, Magnesium, Calcite, Dolomite, Erosion, Calcium, Chemical composition.

Carbonate minerals constitute an important fraction of many lake sediments. No detailed studies have yet been undertaken to establish the relationship between the carbonate mineralogy of lake sediments and that of surrounding soils and deposits. The similarity in carbonate mineralogy of the silt and clay fractions of the Blackstrap sediments to those of the surrounding soils suggests that erosional processes have contributed to the present composition of the lake sediment. In particular, the persistence of dolomite in the silt fractions of the lake sediment is a good indication that part of the calcite together with the dolomite are derived from the surrounding soils. However, the higher carbonate contents of the sediment fractions also indicate that the precipitation of carbonates from the lake waters has been and is likely to still occur. Mollusk shells also contribute to this increase. The presence of Mg-bearing calcite in the lake sediment is attributed to the pecipitation of calcite over a period during which the Mg(2+) ion concentration in the lake was increasing in relation to the Ca(2+) ion concentration. It appears that the Mg:Ca ratio of the waters has a similar effect on the nature of precipitated carbonates as that evident in marine deposits and soils. The unusual presence of Mg-bearing calcite in the sand fraction is attributed to the cementation of finer particles into sand-sized aggregates. (Baker-IVI)
W84-03223

LAGRANGIAN METEOROLOGY AND MEASUREMENTS OF ACIDIC PRECIPITATION AT WASHINGTON, D.C.,
National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Labs.
For primary bibliographic entry see Field 5B.
W84-03286

A COMPARATIVE STUDY OF THE IONIC COMPOSITION OF RAINWATER AND ATMOSPHERIC AEROSOLS: IMPLICATIONS FOR THE MECHANISM OF ACIDIFICATION OF RAINWATER,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and C. A. Pio.
Atmospheric Environment, Vol. 17, No. 12, p 2539-2543, 1983. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Rainfall, *Chemical composition, Chlorides, Nitrates, Sulfates, Magnesium, Potassium, North-West England, England.

Measurements of the chemical composition of rainwater and suspended particles collected in parallel at a rural site in North-West England have shown that sulfate, nitrate, chloride, ammonium, sodium, magnesium, potassium, and calcium ions constitute the main ionic species in atmospheric aerosols and rainwater. Sodium and magnesium are associated with chlorides and originate from sea salt spray. Comparative concentrations in rainwater and parallel aerosol samples indicate that rainout and washout mechanisms are effective in the deposition of sea salt aerosols at this sampling site. Acidity was only present to any appreciable degree in rainwater samples. It appears that at least in this region where the levels of NH3 in the lower atmosphere are usually high and annual rainfall is appreciable, the deposition of acidity is mainly due to wet deposition. Washout and principally rainout mechanisms are efficient in the removal of anthropogenic sulfur compounds. (Baker-IVI)
W84-03287

CHEMICAL COMPOSITION OF WATERBODIES IN THE ENGLISH LAKE DISTRICT: RELATIONSHIPS BETWEEN CHLORIDE AND OTHER MAJOR IONS RELATED TO SOLID GEOLOGY, AND A TENTATIVE BUDGET FOR WINDERMERE,
Freshwater Biological Association, Windermere (England).
D. W. Sutcliffe, and T. R. Carrick.
Freshwater Biology, Vol. 13, No. 4, p 323-352, August, 1983. 13 Fig, 14 Tab, 87 Ref.

Descriptors: *Chemical composition, *Lakes, *Chlorides, *Sodium, *Ions, *Geohydrology, *Windermere, England, Pollution load, Water pollution sources, Groundwater budget, Groundwater pollution, Quantitative analysis.

It is well known that relative proportions and concentrations of most major ions in surface waters are basically dependent on the type of rocks and soils in the catchments. Sodium and chlorine ions are notable exceptions, particularly in maritime regions where it is believed these two ions are cyclically derived largely if not entirely from the oceans, via precipitation, and are concentrated in runoff by evaporation. Mean tarnwater concentrations of Cl(-) and other ions (Na(+), K(+), Ca2(+), Mg2(+), SO4(2-) + NO3(-))decrease with increasing distance from the sea and altitude but are related to solid geology. Lowest concentrations occur on slow-weathering igneous rocks (Borrowdale Volcanics); minima of c. 100 microequiv. Cl(-)/l are similar to the volume-weighted mean for bulk precipitation. At least 10-20% of Na(+) is leached from upland catchments, giving Na(+)/Cl(-) ratios greater than the equivalent ratio (0.86) in seawater and precipitation. Evapotranspiration at 20-30% annual rainfall accounts for Cl(-) concentrations in many tarns on igneous rocks but not all; some Cl(-) may be leached from the rocks in upland catchments and come from groundwaters at low altitudes near the sea. Seaspray has little influence on tarnwaters near the coast. On sedimentary rocks overall mean Cl(-) concentrations are 27-73% higher than equivalent means on Borrowdale Volcanics; concentrations of other ions are also higher. A 5-fold to 10-fold range of Cl(-) concentrations is not simply due to increased evapotranspiration. Na(+)/Cl(-) ratios are < 0.86, especially on Skiddaw Slates where tarn waters contain 10% or more excess Cl(-) balanced by Ca(2+), apparently derived from groundwaters rich in CaCl2. On other sedimentary rocks (Silurian Slates and Carboniferous, Triassic and Permian series) tarn waters display a similar but less pronounced excess of Cl(-) and Ca(2-)(+) relative to Na(+). Some extra Cl(-) may be captured by dry deposition on vegetation but a portion, perhaps 15-30% of the total, apparently comes from the rocks or from groundwaters via deep aquifers in contact with seawater or connate water. In anthropogenic sources on the catchments deicing salt used on highways in winter accounts for a 27% increase of Cl(-) in Windermere South Basin over a 20-year period. (Murphy-IVI)
W84-03293

RELATIONSHIPS BETWEEN CHLORIDE AND MAJOR CATIONS IN PRECIPITATION AND STREAMWATERS IN THE WINDERMERE CATCHMENT (ENGLISH LAKE DISTRICT),
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5B.
W84-03297

THE CONTRIBUTION OF HUMIC SUBSTANCES TO THE ACIDITY OF COLORED NATURAL WATERS,
Canada Centre for Inland Waters, Burlington (Ontario).
B. G. Oliver, E. M. Thurman, and R. L. Malcolm.
Geochimica et Cosmochimica Acta, Vol. 47, No. 11, p 2031-2035, November, 1983. 1 Fig, 2 Tab, 31 Ref.

Descriptors: *Acidity, *Water analysis, *Humic acids, Wetlands, Groundwater, Nova Scotia, Rivers, Lakes, Streams, Fulvic acids.

Many natural waters contain low concentrations of dissolved solids, have low conductivity and possess little alkalinity, so they are highly susceptible to the effects of acid precipitation. An operationally defined carboxy content of humic substances extracted from rivers, streams, lakes, wetlands, and groundwaters throughout the United States and Canada is presented. Despite the diversity of the samples, only small variations were noted in this humic carboxyl content. The dissociation behavior of two combined fulvic-humic acid extracts was studied and the dissociation of the humics varied in a predictable manner with pH. Using a carboxyl content of 10 microeq/mg humic organic carbon, and mass action quotient calculated from sample pH, the ionic balances of three highly colored Nova Scotia rivers were examined. The acidity contribution of humic substances to a watershed was concluded to be equivalent to the carboxylate anion concentration and so can be estimated for colored or dystrophic waters by these procedures. A portion of the acidity may be released in weathering and/or ion exchange reactions in the watershed's soils or sediments. Once the humic materials reach the watercourse, further hydrogen ions may be released through dissociation. This acidity may be present as free hydrogen ions in the water or may be consumed by neutralization reactions in the watercourse. (Baker-IVI)
W84-03332

ACID PRECIPITATION - AN INTERNATIONAL ENVIRONMENTAL PROBLEM,
Norsk Inst. for Vannforskning, Oslo.
L. N. Overrein.
Water Science and Technology, Vol. 15, No. 12, p 1-7, 1983. 5 Ref.

Descriptors: *Acid rain, *International environmental effects, Environmental effects, Sulfur compounds, Nitrogen compounds, Metals, Industrial development Air pollution, Europe, North America.

Acidification is a trans-World problem. The concept of acidification is bound up with the discharge into the atmosphere of sulfur dioxide, nitrogen oxides, and metals and other micropollutants, and the subsequent effects of these substances on the environment. The bulk of man-made emissions occurs over industrialized regions covering less than 5% of the earth's surface. In these regions, man-made emissions exceed the natural emissions by a factor of five to twenty. In the 1950's a sharp rise in oil combustion increased the SO2 emissions in Europe to about 25 million tons of sulfur per years by 1970. European emissions of NO sub x have increased from low values 100 years ago to the present value of about 6 million tons of nitrogen per year. Similar emission trends of SO2 and NO sub x have taken place in North America. Sulfur dioxide emissions in Europe are predicted to remain about the same as present day emission through 1990. Further trends in emission will depend critically on the energy policies of each country and the entire region. Strong acids have decreased the mean annual pH of precipitation in much of Northwestern Europe and large areas of North America to between 4 and 4.5. The sources and environmental consequences of acid deposition are often separated by hundreds, even thousands, of kilometers. The emission source areas exposed to the heaviest depositions will be facing serious

direct and indirect effects on natural ecosystems, materials and possibly even human health. Further, metal toxicity in soils, surface waters and groundwaters with consequences for terrestrial and aquatic life will most likely develop in both heavily polluted and sensitive areas. (Murphy-IVI)
W84-03382

THE ROLE OF SOIL IN DETERMINING SURFACE WATER COMPOSITION,
Macaulay Inst. for Soil Research, Aberdeen (Scotland).
B. W. Bache.
Water Science and Technology, Vol. 15, No. 12, p 33-45, 1983. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Soil properties, *Surface water, *Water properties, Chemical properties, Groundwater, Surface drainage, Rainfall impact, Mineralogy, Physiochemical properties.

The composition of major rivers and large lakes is variable within certain limits, and on a world scale follows a logical pattern controlled by the interplay of three mechanisms, atmospheric precipitation, rock dominance and evaporation-crystallization processes. Incoming precipitation in rural areas passes through soil and weathering rock during passage to surface waters. The composition of the effluent is determined by its hydrologic pathway and by the material through which it flows. Reactions between water and soils or weathering rocks are normally rapid compared with typical residence times, so that the composition of water is derived from the material through which it has passed. Composition data for groundwater, drainage and surface waters illustrate these principles. Apparent deviations are explained by low residence times or unusual catchment properties, and show that detailed mineralogical and physiographic information is important for catchments in sensitive areas, if the factors controlling water composition in these areas are to be understood. (Murphy-IVI)
W84-03384

EFFECT OF RAIN ON SURFACE REAERATION,
Asian Inst. of Tech., Bangkok (Thailand).
R. B. Banks, G. B. Wickramanayake, and B. N. Lohani.
Journal of Environmental Engineering, Vol. 110, No. 1, p 1-13, February, 1984. 4 Fig, 5 Tab, 9 Ref.

Descriptors: *Aeration, *Rain, *Oxygen transfer, Turbulence, Rainfall rate, Air-water interfaces, Dissolved oxygen.

For any river or lake or other body of water, the atmosphere is the primary source of dissolved oxygen in the water. Any mechanism which creates turbulence at or near a water surface will tend to increase the rate of oxygen transfer across the surface. It seems apparent that rain falling on a body of water is a mechanism for the creation of surface turbulence. The energies of raindrops striking the water create cavities, droplets, and surface waves. This phenomenon was examined by conducting 108 laboratory experiments. Test variables were rainfall rate, raindrop diameter and impact velocity, rotational velocity of a mixing impeller, and collector tank depth. The oxygen transfer coefficient is directly proportional to the power of the rainfall. Heavy rainfalls over an extended period of time may contribute significantly to the overall oxygen balance in a body of water. The direct addition of oxygen from raindrops with oxygen concentrations at or near the saturation concentration can be an appreciable fraction of the total amount of oxygen transferred as a consequence of the rainfall. (Moore-IVI)
W84-03468

2L. Estuaries

DISTRIBUTION AND ABUNDANCE OF ZOOPLANKTON IN AN ALKALINE FRESHWATER MARSH IN NORTHUMBERLAND COUNTY, PENNSYLVANIA,
Bucknell Univ., Lewisburg, PA. Dept. of Biology.
P. W. Seelbach, and W. F. McDiffett.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 3, p 379-395, 1983. 9 Fig, 33 Ref.

Descriptors: *Marshes, *Zooplankton, *Species diversity, Population dynamics, Distribution, Temperature effects, Acidity, Nitrogen, Phosphorus, Dissolved oxygen.

The zooplankton community of two ponds in an alkaline marsh in central Pennsylvania were studied. An open-water pond and an open-marsh pond were compared. The ponds were similar with respect to temperature, pH, dissolved oxygen, total dissolved phosphorus, nitrate-nitrite nitrogen, ammonium nitrogen and chlorophyll a. They differed significantly with respect to conductivity, alkalinity, habitat type, vegetation, depth and predation pressure. The open water pond contained cladocerans, cyclopoid and calanoid copepods and rotifers, all of which are common to open, limnetic waters. The nearby marsh pond contained cladocerans, cyclopoid copepods, ostracods and rotifers, all of which are common to littoral habitats. The marsh pond contained more species (35 to 25) than the open water pond, but also supported lower population densities. The zooplankton communities of the two ponds were distinctly different from one another with regards to species, but similar when only zooplankton types are considered. (Baker-IVI)
W84-02956

SPATIAL DISTRIBUTIONS AND HYPOTHETICAL GRAZING PRESSURES OF ZOOPLANKTON IN THE TIDAL, FRESHWATER POTOMAC RIVER,
American Univ., Washington, DC. Dept. of Biology.
C. Buchanan, and J. A. Schloss.
Journal of Freshwater Ecology, Vol. 2, No. 2, p 117-128, July, 1983. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Zooplankton, *Estuarine environment, *Potomac River, Tidal waters, Spatial distribution, Population dynamics, Stratification, Phytoplankton.

Zooplankton in the tidal, freshwater Potomac River were studied to determine whether they could indeed stratify and undergo diel vertical migrations and what grazing pressures could be expected of zooplankton populations in the freshwater reach during the summer of 1981. Four working hypotheses emerged from the study. Zooplankton were usually unstratified due primarily to tidal mixing and they did not undergo the classic pattern of diel vertical migration. Under certain tidal and light conditions, some zooplankton species could stratify in deeper waters for short periods of time. Consequently, the mean vertical distribution of grazing pressure in the water column was slightly skewed toward the bottom. The horizontal distribution of zooplankton in the river was very patchy, and may be due to slow and uneven lateral diffusion of waters after entering the Potomac River. During the summer of 1981, zooplankton populations could hypothetically filter 1.1% to 3.7% of the river volume per day on the average. Grazing pressure was lowest in the Potomac River just below the fall line, at the Memorial Bridge station. Grazing was as high as 9.7%/day in the downstream end of the freshwater reach. (Baker-IVI)
W84-02967

DYNAMICS OF PHYSICAL AND CHEMICAL PARAMETERS IN OKEFENOKEE SWAMP,
Louisville Univ., KY. Systems Science Inst.
R. W. Bosserman.
Journal of Freshwater Ecology, Vol. 2, No. 2, p 129-140, July, 1983. 9 Fig, 2 Tab, 12 Ref. NSF DEB 76-12292 and 78-08842.

Descriptors: *Chemical properties, *Physical properties, *Okefenokee Swamp, *Marshes, Oxygen, Organic compounds, Metals, Water level fluctuations, Temperature effects, Diurnal distribution, Climate.

During 1977 and 1978 diurnal and annual variations of physical and chemical parameters in a marsh within Okefenokee Swamp were examined. The general characteristics of physical and chemical parameters in Okefenokee Swamp marshes were similar to other blackwater ecosystems. Concentrations of dissolved metals are low while concentrations of organic compounds are high. The water is usually acidic with a pH that varies between 3.8 and 4.9. The water chemistry in the swamp is affected by the chemical, physical and biological factors which are dominant on different temporal scales. Climatic factors such as temperature, light, and precipitation are probably the major driving forces operating on an annual basis in the marsh. Water level changes occur on an annual scale because of changes in precipitation, evapotranspiration, inflows and outflows. Calcium, magnesium, and potassium ions are strongly correlated with water levels. During droughts, when water levels are near zero, the marsh environment is drastically altered. Oxygen falls to concentrations near zero, while other elements are elevated. (Baker-IVI)
W84-02968

MANGROVE DISTRIBUTION IN NORTHWESTERN AUSTRALIA IN RELATIONSHIP TO REGIONAL AND LOCAL FRESHWATER SEEPAGE,
V. Semeniuk.
Vegetatio, Vol. 53, No. 1, p 11-31, July, 1983. 12 Fig, 7 Tab, 25 Ref.

Descriptors: *Mangrove swamps, *Tidal flats, Australia, Hydrology, Seepage, Natural waters, Salinity, Groundwater properties, Stratigraphy.

The field studies conducted illustrate the relationship between mangrove distribution and a variety of physico-chemical factors such as tidal flat groundwater, freshwater input, and stratigraphy. The tidal flat stratigraphy is important in its relationship to the hinterland groundwater system and to hinterland drainage patterns, be they surface or internal types. It is this hinterland/tidal-flat stratigraphy that influences freshwater discharge into tidal lands and so has a marked effect on mangrove species distribution. Climate per se is important in that it may provide a short, intense, direct freshwater input and secondly it may regulate evaporation on the high tidal flats. However, long-term freshwater input flowing for most of the dry season will be a far more effective and influential control on mangrove distribution. A freshwater reservoir lies within the hinterland, but the fresh water requires pathways through which it can invade hypersaline groundwater fields if it is to influence mangrove distribution. Analysis of the stratigraphic/hydrologic framework is therefore of importance to understanding mangrove development and zonation, particularly along the landward fringe, because it provides the key to understanding mechanisms of these subterranean freshwater incursions. (Baker-IVI)
W84-02972

GRADIENT ANALYSIS OF THE VEGETATION OF THE BYRON-BERGEN SWAMP, A RICH FEN IN WESTERN NEW YORK,
Ithaca Coll., NY. Dept. of Biology.
J. M. Bernard, F. K. Seischab, and H. G. Gauch, Jr.
Vegetatio, Vol. 53, No. 2, p 85-91, September, 1983. 4 Fig, 1 Tab, 24 Ref. NJF Grant DED-7809340.

Descriptors: *Vegetation, *Fens, *New York, *Byron-Bergem Swamp, Species diversity, Detrended correspondence analysis, Soil properties, Organic matter, Peat, Marl, Hummocks, Swamps.

Transects of contiguous one square meter quadrats were sampled across the marl and peat mosaic of the Byron-Bergen swamp, a rich fen in western New York. The data were analyzed by detrended correspondence analysis (DCA). The ordination successfully separated sedge fen from marl fen vegetation in spite of the high beta diversity (6.99) and further separated hummock from encroaching

forest sites. Neither of these separations was accomplished by alternative ordination techniques. Detrended correspondence analysis offers a significant advantage over reciprocal averaging and earlier ordination techniques for the study of within- and between-community pattern because of its superior performance with long vegetation gradients (more than 4 or 5 half-changes as observed in this study and indicated by the high beta diversity shown). DCA serves to convert species composition data into a vegetational variable whose patterns can then be compared with environmental patterns in order to generate hypotheses about the causes of within-community vegetation patterns. (Baker-IVI)
W84-02973

ENVIRONMENTAL GRADIENTS AND BENTHIC MACROINVERTEBRATE DISTRIBUTIONS IN A SHALLOW NORTH CAROLINA ESTUARY,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
A. J. Chester, R. L. Ferguson, and G. W. Thayer.
Bulletin of Marine Sciences, Vol. 33, No. 2, p 282-295, April, 1983. 6 Fig, 7 Tab, 42 Ref.

Descriptors: *Estuarine environment, *Benthos, Aquatic life, Invertebrates, North Carolina, Estuaries, Distribution, Sediments, Tidal effects.

Environmental gradients and distributional patterns of benthic macroinvertebrates were studied using multivariate statistical analyses in subtidal sediments of a shallow, southeastern United States estuary. Along a major estuarine gradient from fine anaerobic sediments, rich in organic matter and pheopigment to coarse aerobic sediments high in ATP and chlorophyll biomass and numbers of individuals increased significantly. A second environmental gradient within the lower estuary linked high numbers of invertebrates to depositional areas near salt marshes and low numbers to turbulent regions adjacent to deep, tidally-scoured channels. Invertebrate species composition was spatially associated with both environmental gradients. Seasonal patterns of abundance and biomass varied in the estuary, possibly due to differential predation on the dominant species. The observed sediment distributions were consistent with results of earlier studies. (Baker-IVI)
W84-02977

NICKEL TOXICITY TO ESTUARINE/MARINE FUNGI AND ITS AMELIORATION BY MAGNESIUM IN SEA WATER,
New York Univ., NY. Lab. of Microbial Ecology.
For primary bibliographic entry see Field 5C.
W84-02988

FRESHWATER IMPACTS IN NORMALLY HYPERSALINE MARSHES,
San Diego State Univ., CA. Dept. of Biology.
J. B. Zedler.
Estuaries, Vol. 6, No. 4, p 346-355, December, 1983. 4 Fig, 4 Tab, 13 Ref. NOAA grant NA80AA-D-00120.

Descriptors: *Salt marshes, *Floodwater, *Rainfall, Marshes, Saline water, Environmental effects, Flooding, Saline soils, Biomass, Halophytes, California, Tijuana Estuary, Los Penasquitos Lagoon, San Diego River.

Southern California salt marshes usually have hypersaline soils, but heavy rainfall in 1978 and 1980 caused flooding. Freshwater effects were correlated with the degree of change in soil salinity. At Tijuana Estuary (1980), a short-term reduction in the salinity of normally hypersaline soils was followed by a 40% increase in the August biomass of Spartina foliosa. At Los Penasquitos Lagoon (1978), a longer period of brackish water influence was followed by a 160% increase in August biomass of Salicornia virginica. At the San Diego River (1980), flood flows were augmented by major reservoir discharge. Continuous freshwater flow leached most of the marsh soil salts and caused replacement of halophytes by freshwater marsh species. The first two cases fell within the normal range of flooding events, even though the hydrology of both watersheds has been modified. The vegetation response was functional. The productivity increased but there was no major change in species composition. The vegetation rapidly returned to preflood conditions. However, the long-term freshwater flow in the San Diego River was unnatural. Floral composition changed as soils were leached of salts. Recovery following the return of saline soils has been slow because many native halophytes are not good colonizers. Southern California salt marshes are resilient to flooding, but artificially prolonged flooding can cause shifts in composition from which the marsh will recover slowly if at all. Management for the maintenance of natural salt marsh communities must include management of the watershed's hydrology so that the timing and duration of fresh water discharges do not exceed the threshold for compositional changes. (Murphy-IVI)
W84-03036

TRANSIENT HYDRODYNAMIC AND SALINITY SIMULATIONS IN THE CHESAPEAKE BAY NETWORK,
Thatcher Research Associates, Inc., Palisades, NY.
M. L. Thatcher, and T. O. Najarian.
Estuaries, Vol. 6, No. 4, p 356-363, December, 1983. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Salinity, *Bays, Saline water intrusion, Estuaries, Harbors, Chesapeake Bay, Model studies, Atlantic Ocean, Tidal hydraulics.

The temporal and spatial variations of salinity in upper Chesapeake Bay and its tributaries are of interest to water resource planners. Many characteristic estuarine processes are related to the salinity gradients in the system. Also, such gradients affect the magnitude of the non-tidal circulation in estuaries and partially determine the spatial distribution of the resident fauna and flora in the system. Calibration of a model was based on only three external parameters: a friction factor that was spatially described, and two global constants required to calibrate a dynamic dispersion relationship that depended on both the local salinity gradient and hydraulic conditions. The transient hydrodynamics and the transient salinity distribution of the Bay and its tributary estuaries were simulated for the period of one month and comparisons were made between calculated and observed salinities. The dynamics of salt transport in the Bay proper are sensitive to local freshwater inflows. The simulations of salinity during August-September 1969 indicate that, whereas salinities in the lower Bay have an initial decreasing trend due to large freshwater inflows, the trends in the upper Bay are increasing due to the low freshwater inflows from the Susquehanna River during this period. It was not possible to fully verify the capability of the model in simulating the transport of sea salts from the Bay to the tributary estuaries, due to the lack of synoptic data on the salinity concentrations in the tributaries. (Baker-IVI)
W84-03037

THE REPRODUCTIVE CYCLE OF THE BAY SCALLOP, ARGOPECTEN IRRADIANS IRRADIANS (LAMARCK), IN A SMALL COASTAL EMBAYMENT ON CAPE COD, MASSACHUSETTS,
Woods Hole Oceanographic Institution, MA.
R. E. Taylor, and J. M. Capuzzo.
Estuaries, Vol. 6, No. 4, p 431-435, December, 1983. 4 Fig, 1 Tab, 17 Ref. NOAA grant NA80AA-D-00077.

Descriptors: *Estuarine environment, *Scallops, *Massachusetts, *Cape Cod, Shellfish, Hydrology, Spawning, Estuarine fisheries, Water temperature.

Because of its economic importance to coastal communities, an understanding of the dynamics of bay scallop populations is necessary for protection and for effective management of the fishery. The spawning activity of the bay scallop A. irradians irradians was monitored from May through September (1979) in a small embayment on Cape Cod, Massachusetts and compared with changes in hydrographic conditions. Spawning activity of bay scallops began in May and continued through July with some minor activity occurring during August and September. Activity was related to changes in ambient temperature and occurred predominantly before the summer maximum temperatures. As temperatures declined in the late summer and early fall, there was increased gametogenic activity. There was a longer period of spawning activity than previously reported for New England waters. (Murphy-IVI)
W84-03039

OBSERVATION OF EPISODIC SEDIMENTATION IN A TIDAL INLET (SABINE PASS, TEXAS AND LOUISIANA),
Espey, Huston and Associates, Inc., Austin, TX.
G. H. Ward, Jr.
The Texas Journal of Science, Vol. 35, No. 2, p 101-108, July, 1983. 3 Fig, 7 Ref.

Descriptors: *Episodic sedimentation, *Tidal inlet, *Sabine pass, Sedimentation, Tidal effects, Hydrometeorology, Coastal waters, Sedimentation rates, Sediment yield.

Sediment transport is not a constant process, but highly time variable and probably episodic, being dictated by such transient factors as tidal phase, wave climate, and the hydrometeorological regime. The sedimentation monitored with a recording tipping-bucket sampler in Sabine Pass, the inlet connecting Sabine lake (on the Texas-Louisiana boundary) and the Gulf of Mexico was episodic, characterized by events widely spaced in time. There was no apparent relation to astronomical tide, even at maximum declination. Sedimentation tended to be dictated by hydrometeorological factors. The most intense sedimentation episode of the study period (October and November 1978) was associated with the most energetic frontal passage. (Murphy-IVI)
W84-03107

CHEMISTRY OF DISSOLVED AND PARTICULATE MATERIAL IN THE ESTUARY OF THE RIMOUSKI RIVER (CONTRIBUTION A L'ETUDE CHIMIQUE DU MATERIEL DISSOUS ET PARTICULAIRE DE L'ESTUAIRE DE LA RIVIERE RIMOUSKI),
Quebec Univ., Rimouski. Dept. of Oceanography.
N. Belzile, and J. Lebel.
Marine Chemistry, Vol. 13, No. 1, p 15-34, 1983. 13 Fig, 2 Tab, 48 Ref.

Descriptors: *Chemical analysis, *Particulate matter, *Estuaries, *Rimouski River, Alkalinity, Pollution load, Natural flow, Residual chlorine, Fate of pollutants.

Suspended particulate matter (SPM) in the Rimouski River estuary contained dissolved oxygen, silicate, nitrate, phosphate, Mn, Fe and Al. At any given time, total alkalinity (TA) is conservative within the estuary with respect to chlorinity. The TA of the freshwater is related to river flow. This is attributed to dilution of the river water with bicarbonate-poor rainwater. Generally, pH follows the same pattern observed for TA in freshwater. Dissolved oxygen is usually more concentrated in freshwater and decreases linearly with increasing chlorinity. Freshwater is always saturated or supersaturated with respect to O2. Seasonal fluctuations are attributed to temperature variations. There is no evidence for removal of soluble silicate from the freshwater entering the sea. The concentration of silicate in the freshwater is strongly influenced by rainfall. Soil leaching, conditioned by high rainfall increases the concentration of soluble silicate in freshwater. Nitrate behaves similarly whereas phosphate is complicated by the presence of sewage. The Mn, Fe and Al contained in the SPM indicates dilution of river-borne particles rich in Mn by others less rich in this element. A decrease in Mn content with increasing chlorinity and SPM concentration as well as increasing concentrations of SPM with increasing chlorinity indicate that the composition is controlled primarily by physical mixing of material from two sources rather than by chemical processes. Within the ana-

lytical precision the Fe/Al ratio does not vary with the chlorinity. (Murphy-IVI)
W84-03108

THE NATURE RESERVE S'GRAVENDEL (RETIE, BELGIUM); I. PHYTOSOCIOLOGICAL DESCRIPTION IN RELATION TO MOISTURE AND SOIL CONDITIONS (HET NATUURGEBIED 'S-GRAVENDEL (RETIE, BELGIE); I. FITOSOCIOLOGISCHE BESCHRIJVING IN RELATIE TOT VOCHTIGHEID EN BODEM),
Antwerp Univ., Wilrijk (Belgium). Dept. of Biology.
D. Paelinckx, and R. Soetiens.
Bulletin de la Societe Royale de Botanique de Belgique, Vol. 116, No. 1, p 74-92, 1983. 3 Fig, 7 Tab, 22 Ref.

Descriptors: *s'Gravendel Nature Reserve, *Belgium, *Soil water, *Plant communities, Marshes, Heaths, Soil nutrients, Flooding, Minerals, Wetlands.

s'Gravendel is a marshy heath of 11 ha in the northwest of the Campine-district. Strong differences in intensity of earlier flooding with channelwater, rich in minerals, and smaller or larger differences in height cause a complex system of gradients in moisture and nutrient content. We find elements of the Magnocaricion in the wetter and more eutrophic parts of the area. Littorellion-communities occupy the other pools while the dryer ground is covered by Erica and Myrica heaths. (Author's abstract)
W84-03128

NITROGEN LOSSES FROM A LOUISIANA GULF COAST SALT MARSH,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, C. J. Smith, and W. H. Patrick, Jr.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 2, p 133-141, August, 1983. 6 Tab, 17 Ref.

Descriptors: *Salt marshes, *Nitrogen, Louisiana, Gulf Coast, Estuarine environments, Coastal waters, Spartina alterniflora, Nitrogen cycle, Ammonium, Nitrification.

Nitrogen has been identified as the most important nutrient in regulating wetland macrophyte production. Ammonium is the predominant form of inorganic N found in the saturated sediment. Losses of N-15 labeled nitrogen were measured in a Spartina alterniflora salt marsh over three growing seasons. Labelled NH4(+)-N equivalent to 100 micrograms N/g of dry soil was added in four installments over an eight week period. Recovery of the added nitrogen ranged from 93% 5 months after addition of the NH4(+)-N to 52% at the end of the third growing season, This represented a nitrogen loss equivalent to 3.4 g N/sq m. By calculating the rate of mineralization it was possible to estimate the availability of the labelled NH4(+)-N incorporated into the organic fraction. The time required for mineralization of 1% of the tagged organic N increased progressively with succeeding cuttings of the S. alterniflora and ranged from 152 to 299 days. Only 2% of the nitrogen applied at N-15 labelled plant material to the marsh surface in the fall could be accounted for in S. alterniflora the following season. The findings of this study substantiate previous nitrogen studies conducted in this Louisiana Gulf Coast salt marsh. (Baker-IVI)
W84-03199

PLANKTON PRODUCTIVITY AND BIOMASS IN A TRIBUTARY OF THE UPPER CHESAPEAKE BAY. I. IMPORTANCE OF SIZE-FRACTIONATED PHYTOPLANKTON PRODUCTIVITY, BIOMASS AND SPECIES COMPOSITION IN CARBON EXPORT,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
K. G. Sellner.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 2, p 197-206, August, 1983. 1 Fig, 5 Tab, 37 Ref.

Descriptors: *Plankton, *Primary productivity, *Bays, Estuarine environments, Coastal waters, Chesapeake Bay, Phytoplankton, Carbon, Nanoplankton, Estuaries, Zooplankton, Cyanophyta.

Brackish-water tributaries are very productive with high planktonic productivity and faily extensive marsh communities supplying nutrients and organic matter. The contributions of inflowing organic matter and nutrients to the bay could conceivably lead to more eutrophic conditions for this large drainage system if the particulate materials are not utilized within the tributaries. Brackish waters of the lower Gunpowder River, a tributary of the Chesapeake Bay were the site of a 9 month study of phytoplankton productivity, community composition and biomass. Primary productivity followed expected seasonal magnitudes for temperate estuaries with rates exceeding 142.4 mg C/cubic m/hr in July through September of 1979. Minimum rates of 1.6 mg C/cu m/hr were noted in February of 1980. Annual primary production was estimated at 45.5 g C/sq m. Cyanophytes dominated the planktonic algae with cell numbers being highest in August, September and November. Nanoplanktonic forms dominated the primary productivity, chlorophyll concentrations and cell desnties throughout the study. Phytoplankton carbon calculated from cells volumes exceeded nutritional requirements of the pelagic herbivores in all months suggesting a mean daily export of 1607 mg C/cubic m/day to the bay or sediments. Thus the upper Chesapeake Bay may receive significant carbon influx as ungrazed phytoplankton cells, including high densities of procaryotic blue-green algae, from the lower Gunpowder River estuary. The fates of the ungrazed carbon and in particular the high procaryote densities in Chesapeake Bay remain to be determined. (Baker-IVI)
W84-03200

REDUCED RATES OF PRIMARY PRODUCTION IN THE COLUMBIA RIVER ESTUARY FOLLOWING THE ERUPTION OF MT. SAINT HELENS ON 18 MAY 1980,
Oregon State Univ., Corvallis. School of Oceanography.
R. E. Frey, J. R. Lara-Lara, and L. F. Small.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 2, p 213-218, August, 1983. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Environmental effects, *Primary productivity, *Columbia River Estuary, *Mt. Saint Helens, *Turibidity, *Volcanoes, Plankton, Columbia River, Phytoplankton, Light intensity, Light penetration.

A massive increase in suspended particulate material in the Columbia River Estuary resulted from the eruption of Mt. Saint Helens on 18 May of 1980 causing a substantial increase in light attenuation. Photosynthesis, being partly controlled by the depth of light penetration into the water, was reduced by about 75% during the period of increased turbidity. After about five weeks time the estuary was somewhat cleared. During this period the primary productivity in the estuary water column was greatly diminished. However, the flux of particulate carbon through the estuary was high. The total production estimated to have been lost amounted to only about 2% of the total particulate carbon flux just after the eruption. That the high levels of turbidity in the estuary did not induce a severe fall in the phytoplankton population is evidence that phytoplankton biomass concentrations in the Columbia River Estuary are mostly a function of import from the Columbia River, rather than a function of in situ production. Concentrations of organic seston, particulate carbon, and particulate nitrogen were all higher just after the eruption than during cruises 1-month earlier and 2-months later. This indicates that suspended sediment added to the estuary as a result of the eruption contained substantial quantities of organic matter. The food value of this material to estuarine organisms is not known. (Baker-IVI)
W84-03201

FLUORIDE POLLUTION IN FRENCH RIVERS AND ESTUARIES,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
J.-M. Martin, and F. Salvadori.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 3, p 231-242, September, 1983. 11 Fig, 2 Tab, 23 Ref. C.N.E.X.O. Grants 78/1937 and 79/2102.

Descriptors: *Fluoride, *Estuaries, *Rivers, France, Seine River, Gironde River, Charente River, Industrial wastes, Particulate matter, Loire Estuary.

Fluoride has long been considered as an acute pollutant to natural environment because of the ability of plants and marine organisms to accumulate it and because of its detrimental effects upon aquatic biota which can be affected by concentrations as low as 1.5 mg/l. The unpolluted estuary in the Loire has been compared with the Seine, Gironde and Charente where important discharges occur. Natural dissolved concentration can be multiplied by a factor of 30. In the Seine estuary fluorine particulate concentration reached almost 2000 ppm. Anthropic discharge did not influence the percentage between free and complexed dissolved fluoride. The present French rivers discharge of fluoride is 700% higher than the pristine value. At a global scale, dissolved fluoride has probably increased by 25% compared with the natural situation. (Baker-IVI)
W84-03202

TURBULENCE MEASUREMENTS IN STRATIFIED AND WELL-MIXED ESTUARINE FLOWS,
Hydraulics Research Station, Wallingford (England).
H. O. Anwar.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 3, p 243-260, September, 1983. 13 Fig, 1 Tab, 30 Ref.

Descriptors: *Turbulence, *Estuarine environment, Stratification, River Carron, Scotland, Velocity, Salinity, Buoyancy, Energy, Tidal currents, Flow characteristics, Stratified flow.

Velocity distributions were shown to be log-linear in stratified flows and logarithmic in well-mixed flows using mean velocities measured in estuarine flows. The mean salinity profiles are geometrically self-similar and expressible by a power-law. The drag coefficient remains constant at about .0032 in stratified case and is time dependent in well-mixed flow. The gradient and the flux Richardson numbers are almost equal, varying between 0.06 and 0.12, and independent of the flow state. The Monin-Obukhov length-to-depth ratio varies between 0.08 and 0.29. The non-dimensional parameter describing dissipation rates of turbulent kinetic energy remains a constant of about 0.2 and 0.3 for stratified and well-mixed flows, respectively. The nondimensional vertical turbulence coefficient varies between 0.5 and 1.7. The shape of the turbulent energy spectra and co-spectra of longitudinal and vertical velocity fluctuations in stratified flows are broader, and their maxima are lower than those of well mixed flows. (Baker-IVI)
W84-03203

APPLICATION OF NITROGEN-CYCLE MODEL TO MANASQUAN ESTUARY,
T. O. Najarian, P. J. Kaneta, J. L. Taft, and M. L. Thatcher.
Journal of Environmental Engineering, Vol. 110, No. 1, p 190-207, February, 1984. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Nitrogen cycle, *Manasquan Estuary, *New Jersey, *Estuarine environment, Mathematical models, Water quality, Hydrodynamics, Trophic level, Simulation.

A refined version of an ecologic and water quality mathematical model is applied to a small Atlantic coast estuarine network. The temporal and spatial variations in the water quality of the system are examined through the analysis of the nitrogen cycle developed for estuarine environments. The model is based on the mass conservation of elemental nitrogen in its various biotic and abiotic states. The ecologic model structure contains two trophic levels: primary producers, and herbivorous cope-

ods. A concerted effort is made to derive realistic model-governing transformations and rate parameters. The hydrodynamic and water quality model simulations are calibrated and verified using short-term, transient data gathered in the Manasquan Estuary and Point Pleasant Canal. Model verification for abiotic constituents of the nitrogen cycle is achieved, with biotic constituents verfication needing more detailed field data. Model results show the influence of transport processes on the temporal and spatial distribution of nitrogen-cycle constituents in the network examined. (Author's abstract)
W84-03476

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

AUGMENTATION OF RAINFALL FROM SUMMER CUMULUS CLOUDS,
Bureau of Reclamation, Denver, CO. Div. of Atmospheric Resources Research.
A. S. Dennis.
Agricultural Water Management, Vol. 7, No. 1-3, p 3-14, 1983. 3 Fig, 5 Tab, 24 Ref.

Descriptors: *Cloud seeding, *Cumulus clouds, *HIPLEX, Rainfall, Weather modification, Rainfall augmentation, High Plains, Montana, Cloud development, Dry ice.

The latest round of field experiments related to augmentation of rainfall from summer cumulus clouds over the Great Plains is described briefly. HIPLEX (High Plains Cooperative Program) was designed to reduce scientific uncertainty associated with attempts to increase rainfall by cloud seeding in the High Plains. Field programs were conducted at three sites. A randomized experiment, HIPLEX-1, was set up in Montana to test a physical hypothesis linking dry ice seeding to rainfall from cloud base. HIPLEX has confirmed the importance of ice processes to precipitation formation in cumulus clouds of the High Plains and the dominance of mesoscale convergence/divergence fields on convective cloud development. HIPLEX-1 clearly showed increases in cloud ice concentrations associated with dry ice seeding 2 and 5 min after treatment time. Some changes in the subsequent steps in the physical hypothesis linking seeding to increased rainfall at cloud base are indicated but cannot be firmly established with the present data set. (Author's abstract)
W84-03448

UTILIZATION AND ASSESSMENT OF OPERATIONAL WEATHER MODIFICATION PROGRAMS FOR AUGMENTING PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
L. O. Grant.
Agricultural Water Management, Vol. 7, No. 1-3, p 23-35, 1983. 1 Fig, 12 Ref.

Descriptors: *Weather modification, *Assessment, Cost-benefit analysis, Cloud seeding, Rainfall augmentation, Precipitation, Statistical analysis.

There have been and continue to be a significant number of operational weather modification programs for augmenting water supplies. The benefit to cost relationship for such programs is very favorable if even only modest changes in precipitation are produced. The incentive for these programs is particularly strong in the drier, western parts of the country and in all areas during drought periods. Evaluations and assessments are needed in any specific region to both confirm and establish the amount of precipitation change and to provide the basis for improvement in program performance. Interacting factors which must be considered in evaluation or assessing weather modification programs include aspects relating to the organizational, legal, assessment and integration components of such programs. Technical assessment should include assessment related to the operational efficiency of the program, physical studies to verify the occurrence of the chain of events expected from the seeding hypothesis employed, and statistical analyses to establish the changes in precipitation. Physical analyses by independent researchers superimposed on operational programs provide an unique opportunity to facilitate scientific research at less cost and provide significant technical input to the operational program. In such 'piggy back' research efforts, the pertinence of the findings to the operational program is direct, and the cost to the research can be significantly less. Randomization is highly desirable, but if full randomization is not acceptable, some compromises are feasible that can still permit scientific integrity of the analysis. (Moore-IVI)
W84-03449

SOIL MANAGEMENT FOR SEMIARID REGIONS,
Minnesota Univ., St. Paul. Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W84-03450

3C. Use Of Water Of Impaired Quality

USING BLOWDOWN WATER TO IRRIGATE CROPS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, L. H. Stolzy, C. A. Fox, H. J. Vaux, Jr., and I. R. Straughan.
California Agriculture, Vol. 37, No. 3 and 4, p 4-5, March-April, 1983. 4 Tab.

Descriptors: *Irrigation water, *Cooling water, Powerplants, Water reuse, Water conservation.

The reuse of power plant cooling water for crop irrigation was examined for a period of 7 years. The first 3 years of study were conducted in 28 soil lysimeters containing four representative soil types from California. Alternate crops of winter wheat and sorghum were grown using three levels of total dissolved salts, 1,500, 3,000 and 6,500 ppm, which are within the range expected to be found in blowdown. Since the irrigation setup is so much less expensive to construct and maintain than a lined evaporation pond, this method of disposal could save a considerable amount of money. In the arid Southwest, more exotic crops, such as jojoba, guayule, and mesquite, may also be profitable when irrigated with blowdown water. (Baker-IVI)
W84-03218

FERTILIZER AND SALTY WATER EFFECTS ON PHASEOLUS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
R. J. Wagenet, R. R. Rodriguez, W. F. Campbell, and D. L. Turner.
Agronomy Journal, Vol. 75, No. 2, p 161-166, March-April, 1983. 7 Tab, 23 Ref.

Descriptors: *Fertilization, *Saline water, *Phaseolus, Legumes, Saline soils, Irrigation effects, Nutrients, Nitrogen, Phosphorus, Irrigation management, Crop yield.

The response of legumes such as Phaseolus to adverse salt or water regimes is relatively unstudied as a function of soil nutrient status. Greenhouse studies, involving interactive effects on snap bean (P. vulgaris L.) yield of three levels of irrigation water salinity, three frequencies of irrigation water application, two levels of N applied in the irrigation water, and seven levels of P and K fertilization, determine if the adverse effects of saline conditions or water stress on Phaseolus could be overcome by enhanced fertility status and/or improved saline water management on an Argixeroll. Dry matter and bean yields were reduced with decreasing irrigation frequency (2 to 8 days) and increasing salinity of irrigation water (0.5 to 8.0 mmho/cm). Percentage yeild decrements were measured for both salt and irrigation regimes. Yield increases were noted for all fertilizer treatments so long as salinity did not become too high (8 mmho/cm). Plant N content and root weight were responsive to irrigation frequency and salinity, but not to fertilizer form. Nitrogen applied in the irrigation water produced increased yield across all treatment in one set of experiements where greenhouse conditions were hot, dry, and of high potential evapotranspirational demand. No N effect was measured in a second series of experiments with low potential ET. (Murphy-IVI)
W84-03239

EFFECTS OF WASTEWATER IRRIGATION AND PLANT AND ROW SPACING ON SOYBEAN YIELD AND DEVELOPMENT,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
M. J. Cordonnier, and T. J. Johnston.
Agronomy Journal, Vol. 75, p 908-913, November-December, 1983. 1 Fig, 5 Tab, 16 Ref.

Descriptors: *Wastewater irrigation, *Irrigation effects, *Cultivation, *Soybean yield, Municipal wastewater, Dry matter, Chemical analysis, water quality.

Considerable research has demonstrated that soybean 'Glycine max (L.) Merr.' yields can be increased with the addition of supplemental water during reproductive stages, but little information is available concerning the use of municipal wastewater as the water source. Variables included in this field study were: three water regimes-municipal wastewater, well water and no water; two row spacings-51 and 76 cm; two in-row spacings-20 and 32 plants/m and two cultivars-Nebsoy and Harcor. Soybeans planted on a Miami silt loam soil (fine-loamy, mixed, esic Typic Hapludalf) received a total of 9.8 cm of wastewater or well water as overhead spray irrigation in 1979 and 9.4 cm in 1980. Seed yields were significantly different for water treatments in 1979 with 2,430, 2,580, and 2,790 kg/ha for no water, well water and wastewater, respectively. Yields generally increased as plant population increased with the greatest yield for both cultivars occurring at the highest plant population (645,500 plants/ha). Irrigated plants were 4 to 5 cm taller, matured 5 to 6 days later, had larger seeds and lodge slightly more than nonirrigated plants. The two cultivars responded differently to the wastewater, with Harcor exhibiting a better response than Nebsoy. The 1980 growing season was wetter than normal and there was little or no yield response to irrigation. Under the conditions of soil type, climate and wastewater quality found during this experiment, wastewater was generally superior to well water in increasing yields. (Murphy-IVI)
W84-03271

LEACHING REQUIREMENT FOR SALINITY CONTROL III. BARLEY, COWPEA, AND CELERY,
Agricultural Research Service, Riverside, CA. Salinity Lab.
G. J. Hoffman, and J. A. Jobes.
Agricultural Water Management, Vol. 6, No. 1, p 1-14, 1983. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Leaching requirement, *Barley, *Cowpea, *Celery, *Salinity, Crop yield, Irrigation, Evapotranspiration.

Leaching requirement, the smallest steady-state leaching fraction which prevents any loss in crop yield, was determined for barley, cowpea, and celery in field plots at the U.S. Salinity Laboratory. Six replicated leaching-fraction treatments were irrigated many times each day with small quantities of water having an electrical conductivity of 2.3 dS/m. The crops were grown in succession between January 1979 and September 1981. The leaching requirement (Lr) was 0.10 for barley grain and 0.13 for barley forage. For cowpea seed, Lr was 0.16; 0.17 for cowpea forage, Lr for celery was 0.14. These experimentally determined values for barley and cowpea seed are higher by about 0.05 than those predicted by a leaching-requirement model based on an exponential crop water-uptake pattern. The experimental values for celery

and cowpea forage are lower than predicted values by 0.06. These differences are not considered significant, however, when considered in terms of the small differencs in water applications (about 25 mm) to cause these changes in Lr. Evapotranspiration during each crop's growing season coincident with Lr was 410, 630, and 460 mm for barley, cowpea, and celery, respectively. (Author's abstract)
W84-03431

3F. Conservation In Agriculture

RESIDUE MANAGEMENT AND CULTURAL PRACTICES FOR A SEMIARID REGION,
Agricultural Research Service, Big Spring, TX.
J. D. Bilbro, and D. W. Fryrear.
Journal of Soil and Water Conservation, p 312-314, May-June, 1983. 6 Ref.

Descriptors: *Water conservation, *Erosion control, *Residue management, *Semiarid lands, Crop residues, Infiltration, Soil erosion, Agricultural runoff, Wind erosion, Mulches, Cotton, Grasses.

In many regions of the United States, crop residue, if properly managed, can greatly minimize wind and water erosion and increase infiltration of precipitation. The use of applied mulches and residue grown in-place in the blank rows of the planting pattern of two rows of cotton alternated with two blank rows, and the use of perennial plants as wind barriers a top small, parallel terraces are two types of residue management. Three tons/acre of cotton gin trash and 4.5 tons/acre of millet residue applied as mulches to the blank rows of a two by two pattern in 1982 increased cotton lint yields by 47 lbs/acre, a 24% increase and 144 lbs/acre (90%), respectively. Additional quantities of either mulch did not significantly increase lint yields. Growing either millet or pigweeds in the blanks of a two by two pattern in 1982 reduced lint yields drastically and by essentially the same amounts, regardless of whether the millet and pigweeds were mowed two, four, five or six times from June through September. Lint yields of plants adjacent to the millet and pigweed plots were reduced by an average of 112 lbs/acre (69%) and 162 lbs/acre (93%), respectively. All millet and pigweed plots, except those that had been mowed after July 27, had enough residue on February 10, 1983, to prevent wind erosion. A 27.5 inch-wide band of the native grass Texas panicum produced enough residue in 1982 to keep soil losses in the adjacent 56 feet below 5 tons/acre if the erosive winds are perpendicular to the band of grass. Single rows of Ermelo lovegrass and Kleingrass Sel. 75 atop small, parallel terraces spaced 62 feet apart did not significantly affect lint yield of cotton grown between the terraces. A single row of Aztec Maximilian sunflower reduced yields 38%. The two grasses adequately protected the 62 foot interval from erosion by perpendicular winds. The less dense sunflower barrier would protect no more than a 40 foot interval. (Murphy-IVI)
W84-03063

IRRIGATION DECISIONS SIMPLIFIED WITH ELECTRONICS AND SOIL WATER SENSORS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 2G.
W84-03183

SIMULATING THE EFFECTS OF WEATHER VARIABLES AND SOIL WATER POTENTIAL ON A CORN CANOPY TEMPERATURE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
B. Choudhury.
Agricultural Meteorology, Vol. 29, No. 3, p 169-182, 1983. 6 Fig, 29 Ref.

Descriptors: *Soil water potential, *Canopy, *Plant water potentials, Evaporation, Water loss, Irrigation, Temperature effects, Soil properties, Corn, Plant growth, Leaves, Water potential, Water stress, Soil-water-plant relationships.

It has long been recognized that plant temperatures can be used as an indicator for soil water status. When the plant available soil water decreases, the canopy temperature increases. A soil-plant-atmosphere model based on the solution of Monteith's and van den Honert's equation for transpiration is used to study the dependence of corn canopy temperature on weather variables, soil water potential and rooting density. For unstressed canopies, air and dewpoint temperatures appear as the significant weather variables affecting the canopy temperature during a significant portion of clear-sky day periods. The present simulation gives a quasi-linear relationship between the canopy-air temperature difference and the air vapor pressure deficit. The relationship, however, is found to depend on the rooting density and hence on the soil strength. The canopy-air temperature difference values at lower soil water potentials are linearly related to the same values at field capacity, the coefficients (intercept and scope) of this relationship being dependent on the soil water potential through the crop water stress index. The variation of crop water stress index with the soil water potential is given for a silt loam soil. The stomatal resistance function is a pivoting relationship in a soil-plant-atmosphere model. (Baker-IVI)
W84-03210

INCIDENTAL EFFECTS OF AGRICULTURAL WATER CONSERVATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
D. C. Davenport, H. J. Vaux, Jr., and R. M. Hagan.
California Agriculture, Vol. 37, No. 3 and 4, p 28-31, March-April, 1983. 3 Fig, 1 Tab.

Descriptors: *Water conservation, *Agriculture, Irrigation practices, Farming, Cost analysis, Economic aspects, Management, Water quality, Water supply.

Over 400 potential incidental effects of agricultural water conservation actions are identified and divided into 23 categories. Identification of an incidental effect does not always show the magnitude of its importance, which depends partly on local conditions and partly on the extent of the water conservation action. Energy related effects occur both on and off the farm, depending on the specific conservation action and source of water. In general, the most pertinent on-farm effects are those related to farm net returns including production input factors, such as energy, fertilizer, labor, management, and other production costs and those related to production output, namely crop responses to water quantity and quality, to pathogens, to pests and the risks associated with conservation actions that affect the yield of marketable produce. Most of the 23 categories of incidental effects identified have both private and external impacts. Methods of estimating both private and external technological costs and benefits are well developed both conceptually and theoretically. Recognition of some incidental effects may give growers additional incentives to conserve water. (Baker-IVI)
W84-03219

IRRIGATION SCHEDULING UNDER SALINE HIGH WATER TABLES,
California Univ., Davis. Cooperative Extension.
S. W. Kite, and B. R. Hanson.
California Agriculture, Vol. 38, No. 1 and 2, p 12-14, January-February, 1983. 4 Fig, 1 Tab.

Descriptors: *Soil salinity, *Soil water, *Salinity, Water table, Irrigation practices, Irrigation, Water supply, Leaves, Water potential, Water stress.

A technique has been developed for scheduling an irrigation program for a farm of 48 hectares in a saline high water table area. Maximum depth to the water table during the summer was about 4 feet. The electrical conductivity of the drainage water was about 4500 ppm, while that of the irrigation water was about 130 ppm. The soil type was mainly Armona clay for the top 10 inches. The rest of the soil profile was highly stratified with lenses of sand, silt or clay. Cotton was grown during the period of this project. An increase in irrigation intervals resulted in greater soil moisture depletion. Soil moisture depletion was greater when the pressure chamber was used for irrigation scheduling. Normally, intervals between irrigations under saline conditions should be smaller than those under nonsaline situations to minimize yield reductions. However, in this study the interval could be increased and it was suggested that soil moisture rather than soil salnity may have been the controlling factor for scheduling irrigations at that location. (Baker-IVI)
W84-03222

COMPUTER SCHEDULES IRRIGATION,
Montana State Univ., Bozeman.
J. Bauder.
Crops and Soils Management, Vol. 35, No. 8, p 15-17, June-July, 1983. 4 Fig.

Descriptors: *Irrigation practices, *Computers, Irrigation, Water supply, Rain gages, SCHEDULE, Soil water.

Proper irrigation scheduling is somewhat like keeping track of the balance of a minimum balance checking account, while at the same time trying to decide how much should go into savings and how much should go into checking. A computer program has been developed that can help a person keep track of the balance of water available in an irrigation system, tell how fast the water is being taken out by the growing crop, give the anticipated date when the minimum amount of water will be left in the system and the amount that should be added to replenish this amount. At the beginning of the growing season the irrigator establishes a file for his particular field. This file contains information on the crop to be grown, its date of emergence, and the type of soil involved. As the season progresses, the irrigator adds information on rainfall and other weather conditions. The computer calculates the rate of growth of the crop and the amount of water it will have used, then tells how much water should be left in the soil and when more will be needed. (Baker-IVI)
W84-03230

ROOT DISTRIBUTION AND WATER USE EFFICIENCY OF ALFALFA AS INFLUENCED BY DEPTH OF IRRIGATION,
Mississippi State Univ., Mississippi State. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W84-03241

IRRIGATION REGIME EFFECTS ON SOME PHYSIOLOGICAL RESPONSES OF POTATO,
Agricultural Research Organization (Israel). Gilat Regional Experiment Station.
For primary bibliographic entry see Field 2I.
W84-03244

CROP YIELD - IRRIGATION RELATIONSHIPS IN A GYPSIFEROUS-SODIC SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
D. Russo.
Agronomy Journal, Vol. 75, May-June, p 427-434, 1983. 6 Fig, 4 Tab, 15 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Gypsiferous-sodic soil, Soil water suction, Salinity, Soil water potential, Bell pepper, Tomatoes.

Many desert soils in the Arava Valley of Israel contain appreciable amounts of stones, gypsum, and exchangeable Na, and very high salinity . Plant growth in such soils is dependent primarily on the possibility of leaching the soil prior to the growing season as well as on controlling the soil water content and salinity within the root-zone during the growing season. Three different amounts of water (in terms of pan evaporation) at two different irrigation frequencies (daily irrigation and irrigation every 3 days) resulted in different soil water suction and salinity profiles, each of which can be characterized by a time average and the variance about this average. Average (over

ne) soil water potential (ave psi) increased as
)th the amount of irrigation water (Q') and the
igation frequency (I) increased. For a given I,
e (ave psi)-Q' relationships can be described by a
perbolic function. In the gypsiferous-sodic soil
e salinity of the soil solution was highly correlat-
with the exchangeable Na of the soil, which, in
rn, was reduced with added irrigation water.
elative yields, Y, of the two crops were linearly
pendent on the variance of the soil-water poten-
l, independent of the irrigation regime. This
plies that the yield-soil-water potential relation-
ip can be described by a quadratic function. As
posed to the unique Y-(ave psi) relationships, the
-Q' relationships depend on the irrigation fre-
iency. For a given Q', yields of both crops ob-
ined under daily irrigation were higher than the
elds obtained under irrigation once in 3 days.
ighest fruit yields were 126.1 Mg/ha of tomatoes
d 62.7 Mg/ha of bell pepper; the respective
nounts of irrigation water were 1,013 and 2,164
m (109%) and 160% of the evaporation from a
lass A pan). (Murphy-IVI)
V84-03248

EAF AND CANOPY TEMPERATURES OF EARL MILLET GENOTYPES UNDER IRRI-ATED AND NONIRRIGATED CONDITIONS,
nternational Crops Research Inst. for the Semi-rid Tropics, Patancheru (India).
. Singh, and E. T. Kanemasu.
gronomy Journal, Vol. 75, p 497-501, May-June, 983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Irrigation effects, *Leaf tempera-ures, *Canopy temperatures, *Pearl millet, Water tress, Plant water potential, Transpiration, Drought resistance.

Previous research reports that leaf and canopy emperatures correlate with the level of water tress in a plant. If genotypes of a given species iffer in their response to water stress, then leaf nd canopy temperatures could serve as indices of heir drought resistance. To test this hypothesis, 10 earl millet (Pennisetum americanum (L.) Leeke) genotypes differing in plant morphology were grown on a Eudora silt loam soil (fine silty, mixed, mesic, Pachic Haplustoll) under both irrigated and nonirrigated conditions. Leaf temperature (Tl), canopy temperature (Tc), canopy minus air temperature (Tc - Ta), leaf-water potential (psi sub l),leaf-diffusion resistance (LDR), water use (WU), and crop yields were observed in both irrigated and nonirrigated treatments. Significant differences ($P<0.05$) were in the grain yield, Tc, and Tc-Ta of genotypes, only in the irrigated treatment. Grain yield was negatively and significantly correlated with average afternoon Tc($r = -0.81$) and average afternoon Tc - Ta($r = -0.78$). Grain yield ratio (nonirrigated grain yield/ irrigated grain yield) was positively and significantly correlated with average afternoon Tl($r = 0.64$), average afternoon Tc($r = 0.64$), and average afternoon Tc - Ta($r = 0.75$). In the nonirrigated treatment, however, correlations of grain yield and grain yield ratio with various stress indices were insignificant. Average afternoon Tc and Tc - Ta was significantly correlated with average afternoon LDR only in the irrigated treatment. Average afternoon Tc and Tc - Ta in a nonstressed environment with an infrared thermometer could effectively be used as a technique to screen millet genotypes for their grain yield and grain-yield stability (nonirrigated grain yield/irrigated grain yield). (Murphy-IVI)
W84-03251

FERTILIZER APPLICATION AND IRRIGATION MANAGEMENT OF BROCCOLI PRODUCTION AND FERTILIZER USE EFFICIENCY,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
J. Letey, W. M. Jarrell, N. Valoras, and R. Beverly.
Agronomy Journal, Vol. 75, p 502-507, May-June, 1983. 5 Fig, 4 Tab, 6 Ref. OWRT project B-203-CAL. WRC project UCAL-WRC-W-564. OWRT and USDI grant Public Law 88-379. California Water Resources Control Board contract 9-029-400-0.

Descriptors: *Fertilization, *Irrigation management, *Broccoli, Irrigation efficiency, Nitrogen, Furrow Irrigation, Crop yield, Irrigation effects, Evapotranspiration.

Fertilizer and irrigation must be managed for efficient resource use and preservation of environmental quality as well as maximum production. Two furrow irrigation experiments growing broccoli (Brassica oleracea) were conducted. The first consisted of three N rates (90, 180, and 270 kg/ha), two irrigation treatments (replenishment of water lost by evapotranspiration and evapotranspiration plus 30%), and two N application procedures (application to the soil and in the irrigation water) on a sandy loam soil (coarse-loamy, mixed, thermic Typic Xerofluvent). Plant growth increased with increasing N application. For a given N application, there was higher average production with the lesser amount of water application. The method of N application had very little effect on production under the lower irrigation treatment, but production was consistently higher for N application with water rather than to the soil when the higher water application treatment was used. The ratio of N in the plant to N applied decreased with increasing N application, decreased with higher water application, and decreased with application in the irrigation water as compared to soil application. The second experiment consisted of two N rates (115 and 225 kg/ha) and two N application procedures (application to soil and in the irrigation water) on a loamy soil (fine-loamy mixed, thermic Calcic Haploxeroll). Yield and N uptake were significantly higher with 225 as compared to 115 kg/ha of N. Conventional preplant and side-dress N application to the soil resulted in significantly higher broccoli head yield than injecting N in the irrigation water. Leaching of N was not a factor under the experimental conditions. (Author's abstract)
W84-03252

EFFECT OF FOLICOTE ANTITRANSPIRANT APPLICATION ON FIELD GRAIN YIELD OF MOISTURE-STRESSED CORN,
New Mexico State Univ., Las Cruces.
H. D. Fuehring, and M. D. Finkner.
Agronomy Journal, Vol. 75, No. 4, p 579-582, July-August, 1983. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Folicote antitranspirant, *Crop Yield, *Moisture stress, *Corn, Antitranspirants, Environmental effects, Evapotranspiration, Transpiration, Drought, Moisture retention, Soil moisture retention, Optimum development plans.

Drought is one of the most important factors limiting the production of field crop. It has been established that the proportion of stomatal resistance to total resistance is less for carbon dioxide diffusion into the leaf than for water diffusion out of the leaf. Folicote, a hydrocarbon film-type antitranspirant, was foliarly applied on moisture-stressed field corn (Zea mays L.) grown on Pullman silty clay loam (fine, mixed, thermic Torrertic Paleustoll) soil. Single seasonal applications (foliar spray with ground rig just prior to tasseling) resulted in average yield increases of 11 and 17%. Fields where both the upper and lower leaf surfaces were sprayed required 1.93 L/ha for maximum yield responses, 42% less than required where spraying was from the top only. The response was curvilinear with definite yield depression when rates were too great, indicating the need to determine optimum application rates according to the method of application. It was concluded that antitranspirant application is a feasible method of increasing corn yield under the conditions of this study. (Murphy-IVI)
W84-03255

YIELD AND WATER USE EFFICIENCY OF GRAIN SORGHUM IN A LIMITED IRRIGATION-DRYLAND FARMING SYSTEM,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 2I.
W84-03258

RESPONSE OF DRY BEANS TO DAILY DEFICIT SPRINKLER IRRIGATION,
Agricultural Research Service, Prosser, WA.
D. E. Miller, and D. W. Burke.
Agronomy Journal, Vol. 75, p 775-778, September-October, 1983. 1 Fig, 3 Tab, 9 Ref

Descriptors: *Beans, *Sprinkler irrigation, *Water deficit, Irrigation requirements, Water requirements, Soil moisture retention, Water stress, Soil texture.

Dry beans (Phaseolus vulgaris L.) are an important irrigated crop in the Pacific Northwest, but no information is available as to their water requirements under high-frequency sprinkler irrigation. The present study evaluates the response of dry beans to variable amounts of water applied daily by sprinkler, as affected by soil water-holding capacity. Studies were conducted on a Warden loam (coarse-silty, mixed, mesic Xerollic Camborthids) near Prosser, Wash., and on a Quincy sand to loamy sand (mixed, mesic Xeric Torripsamments) near Paterson, Wash. Irrigated was uniformly by solid-set sprinklers until near the time of full canopy, when irrigation variables were initiated and continued until harvest. On the loam soil yields were not reduced when daily sprinkler irrigation was much less than estimated evapotranspiration (ET). No more than 10 to 15 cm of water need be applied from full cover until harvest. On the sandy soil, yields increased with water applied up to the equivalent of nearly 100% estimated ET. On the sandy soil, with limited water holding capacity, it is not possible to reduce irrigation to much below estimated ET without loss in yield. (Murphy-IVI)
W84-03262

EVAPOTRANSPIRATION AND YIELD ESTIMATION OF SPRING WHEAT FROM CANOPY TEMPERATURE,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2D.
W84-03264

RESPONSE OF SOYBEAN CULTIVARS TO IRRIGATION OF A CLAY SOIL,
Agricultural Research Service, Stoneville, MS.
L. G. Heatherly.
Agronomy Journal, Vol. 75, p 859-864, November-December, 1983. 2 Fig, 6 Tab, 29 Ref.

Descriptors: *Soybeans, *Irrigation effects, *Clay soil, Soil texture, Soil water potential, Crop yield, Soil-water-plant relationships.

Numerous investigations have shown that soybeans 'Glycine max (L.) Merr.' will give a significant yield response to irrigation, especially when the supplemental water is applied during reproductive development. However, the majority of these results have been obtained with soils ranging in texture from silt loam to sandy loam. Since soybeans are frequently grown on finer-textured soils, we conducted field experiments in 1979 and 1980 on Sharkey clay (Vertic Haplaquept, very-fine, montmorillonitic, thermic), a soil representative of that occurring in about 3 750 000 ha of the alluvial plain of the Mississippi River. Variables included initiation of furrow irrigation at the prebloom (V), beginning of bloom (BL), beginning of pod set (PS), and beginning of pod fill (PF) stages, plus a nonirrigated (NI) treatment, and three cultivars representing Maturity Groups V ('Bedford'), VI ('Tracy'), and VII ('Bragg'). Data were collected for seed yield, mature plant height, lodging, xylem pressure potential, leaf area, and seasonal soil moisture status. In the 'wet' year of 1979, yields from irrigated Bedford and Tracy were not significantly greater than the respective NI yields of 2754 and 3368 kg/ha. The PF treatment of Bragg produced a yield of 36.30 kg/ha, however, and this was significantly higher than the yields of all other treatments of Bragg, as well as all treatments of Bedford. In the dry year of 1980, all irrigation treatments of all cultivars increased yields about the NI treatment, although the PF treatment yields were only about one-half of those from PB or BL treatments, which were nearly equal. Seed yield was highest from Bragg and lowest from Bedford

in all cases. Lodging was not significantly affected by any irrigation treatment. Mature plant height was significantly increased only in the BL treatment of Bedford in 1980. Measurements of xylem pressure potential, leaf area, and soil water potential in 1980 indicated that the NI plots were severly stressed; thus, response to irrigation should have been expected. Irrigation of soybeans growing in a clay soil should be initiated at or near bloom in a dry year, and at any period of stress during reproductive development in a 'wet' year. (Murphy-IVI)
W84-03268

IRRIGATION OF SOYBEAN GENOTYPES DURING REPRODUCTIVE ONTOGENY. I. AGRONOMIC RESPONSES,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W84-03279

ALFALFA RESPONSE TO SOIL WATER DEFICITS. I. GROWTH, FORAGE QUALITY, YIELD, WATER USE, AND WATER-USE EFFICIENCY,
Minnesota Univ., St. Paul. Dept. of Agronomy and Plant Genetics.
For primary bibliographic entry see Field 2I.
W84-03281

NUMERICAL ANALYSIS OF SOIL WATER MOVEMENT UNDER CONDITIONS OF RAPID INTERMITTENCY OF WATER APPLICATION,
Banaras Hindu Univ., Varanasi (India). Dept. of Geophysics.
For primary bibliographic entry see Field 2G.
W84-03418

EFFECT OF SMALL IRRIGATION AMOUNTS ON THE YIELD OF WHEAT,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Soils.
P. R. Gajri, and S. S. Prihar.
Agricultural Water Management, Vol. 6, No. 1, p 31-41, 1983. 3 Fig, 6 Tab, 6 Ref.

Descriptors: *Crop yield, *Wheat, *Supplemental irrigation, Dry farming, Soil texture, Runoff, Water stress.

In dryland agriculture the amount of water accessible to crops depends upon the amount of stored water in the potential rooting zone and rainfall during the growing season. Where rainfall exceeds the water storage capacity of the soil or its intensity exceeds the infiltration capacity of the soil, the surface runoff may be collected during part of the year and stored for supplemental irrigation. Field experiments were conducted over a period of 4 years on loamy sand and 3 years on sandy loam to study the effects of pre-seeding, post-seeding and split application of limited amounts of water on dry matter accumulation and grain yield of wheat. Early season water stress decreased the rate of dry matter accumulation. Grain yield responded significantly to irrigation 30 days after seeding irrespective of the amount of water, year and soil type. Yield with post-seeding irrigation averaged 3518 kg/ha against 2317 kg/ha for unirrigated control in loamy sand and 4440 kg/ha against 3391 kg/ha in sandy loam. The increase in yield was manifested by a significant increase in the number of effective tillers per m row length, number of grains per ear and thousand grain weight. Under dryland conditions wheat yields can be increased and stabilized by a small irrigation of stored water. This irrigation is more crucial in coarse textured than in fine textured soils. For maximum benefit the stored water must not be applied until a few weeks after seeding in coarse textures soils. On finer textured soils the entire available water may be applied at the time of seeding. (Moore-IVI)
W84-03434

CROP WATER REQUIREMENTS FOR RAINFED AND IRRIGATED GRAIN CORN IN CHINA,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 2D.
W84-03435

AN ELECTRICAL ANALOGUE TO DESIGN SUBIRRIGATION SYSTEMS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
F. Homma.
Agricultural Water Management, Vol. 6, No. 4, p 321-333, 1983. 10 Fig, 1 Tab, 8 Ref.

Descriptors: *Subsurface irrigation, Irrigation, Water supply, Netherlands, Water loss, Seepage, Groundwater flow, Water table, Model studies, Drought.

In humid areas such as northwestern Europe an excess of water occurs during winter. In the Netherlands, where drainage systems are usually well developed, damage to crops because of waterlogging of the soil rarely occurs, but during summer a water shortage may occur, caused by high evapotranspiration rates. In order to overcome possible damage from a water shortage in summer, the water level in the ditch and canal system in several areas is kept high by letting water in. Filling the drainage system with water causes an inflow into the soil, preventing a groundwater table drop, so the crops are fed by groundwater throughout the growing season. Subsurface irrigation is used in the northeastern part of the Netherlands to prevent drought damage to crops on reclaimed peat soils. Even so, high water losses due to deep seepage often prevent the building up of sufficiently high groundwater tables. Field data from a subsurface irrigation experimental field are presented to construct resistor network models to simulate the groundwater flow in the field and its surroundings. The model shows very good agreement with field data. Models were also used to simulate other conditions in order to detect the influence of ditch water levels and the effect of irrigation applied over a larger area. (Baker-IVI)
W84-03443

SOIL MANAGEMENT FOR SEMIARID REGIONS,
Minnesota Univ., St. Paul. Dept. of Soil Science.
W. E. Larson, J. B. Swan, and M. J. Shaffer.
Agricultural Water Management, Vol. 7, No. 1-3, p 89-114, 1983. 16 Fig, 1 Tab, 86 Ref.

Descriptors: *Semiarid lands, *Soil management, Water storage, Water use, Climate, Computer models, Simulation, Soil properties, Crop yield, Residue management, Tillage, Fallowing.

Water related climatic factors and soil physical and chemical properties exert a dominant effect on crop production in semiarid regions. Soil management practices which beneficially affect crop production by increasing water storage or through more efficient water use have been intensively studied at a number of locations with their associated soil conditions and under the climatic conditions encountered. The practical benefits of such research have been extensive. The application of field research to specific sites is restricted by the extreme variations in climatic conditions, by the large differences in soil physical and chemical properties, and by the variation in management practices which occur in the region. Because of these soil and climatic differences, the probability levels of expected responses to management practices generally have not been determined. Part of the difficulty has been due to the inability to precisely define and numerically describe the soil and climatic characteristics involved for sites and years other than those in which the research was conducted. Computer-based simulation techniques permit the development of long- and short-term site specific soil management recommendations with expected results expressed on a probability basis. The research results from specific geographic locations measured under a specific set of climatic conditions can thus be generalized to a much wider range of soils and expressed on a probability basis using long-term climatic records. Examples are given where crop yield frequencies are computed as a function of long-term climatic conditions involving various management practices. These results illustrate the impacts of a range of residue management, deep tillage, and fallowing practices on crop production in the semiarid environment. The modeling techniques presented can be used with a range of models and potential management practices. (Author's abstract)
W84-03450

PRINCIPLES OF WATER MANAGEMENT UNDER DROUGHT CONDITIONS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
W. R. Gardner, and H. R. Gardner.
Agricultural Water Management, Vol. 7, No. 1-3, p 143-155, 1983. 8 Fig, 8 Ref.

Descriptors: *Water management, *Drought, *Dry farming, Crop yield, Summer fallow, Water harvesting, Surface water management.

In rain-fed agriculture the options for water management are much more limited than for irrigated agriculture and the management tools available to the farmer are few. The major variable at his disposal is the selection of the crop to be grown. The economic return per unit of water is the major factor to be considered. This usually implies the maximum possible ratios of grain or other harvested plant part to total dry matter. When the rainfall is just below amount needed for maximum dry matter production, this maximum can be achieved through appropriate manipulation of the plant population. The optimum population depends both upon the characteristics of the plant and the amount and distribution of the precipitation. When the amount of precipitation is significantly less than about 25% of the optimum, then other management approaches are required. A widespread solution to this problem has been summer-fallowing. However, in certain circumstances some variation on surface water management or water harvesting may be more advantageous. Criteria for decision making for optimum production under dry-land conditions are given. (Author's abstract)
W84-03451

IRRIGATION IN THE GREAT PLAINS,
Kansas State Univ., Manhattan. Dept. of Agronomy.
E. T. Kanemasu, J. L. Steiner, A. W. Biere, F. D. Worman, and J. F. Stone.
Agricultural Water Management, Vol. 7, No. 1-3, p 157-178, 1983. 4 Fig, 3 Tab, 102 Ref.

Descriptors: *Irrigation scheduling, *Great Plains, Soil water, Root zone, Evaporation, Transpiration, Hydrologic budget, Water stress, Economic aspects, Model studies.

Irrigation scheduling answers the question of when to irrigate and how much. The techniques used for scheduling include the monitoring of soil moisture, physiological indicators and water balance models. The areas of major concern are: a soil moisture sensor which is inexpensive, rapid and accurate; a means of assessing the upper and lower limits of soil water content in the changing root zone; development of a rapid technique for estimating leaf area; and a means of measuring canopy transpiration. A major research thrust than can be identified is the separation of evaporation from the soil surface and transpiration by the canopy. As one manipulates the canopy geometry to assess the culturral practices and irrigation systems, the need to clearly identify the contribution of evaporation and transpiration becomes increasingly important. The objective for irrigation for the farmer is to maximize his net returns. There are three components of an economic model for determining that decision: a water balance; a growth response function; and an economic optimization function. A few of the problem areas in such a scheme are: adaptation by the plant to water stress; dynamics of the root system; interaction between fertility and water; and risk analysis. (Author's abstract)
W84-03452

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

OPERATIONAL FLOOD ROUTING FOR HYDROELECTRIC PLANTS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
International Water Power and Dam Construction, Vol. 35, No. 9, p 24-27, September, 1983. 2 Fig, 2 Tab, 8 Ref.

Descriptors: *Flood control, *Design criteria, *Powerplants, Construction, Model studies, Flood routing, Stochastic process, Hydraulic models, Greece.

A stochastic model is presented for transferring flood streamflows with lateral inflows. The model overcomes former difficulties and has been used successfully in the design and operation of hydroelectric plants. Calibration of hydraulic flood routing models is based on field information which is limited and extremely variable in space and time for most large natural streams. Thus, serious difficulties and inaccuracies are caused when hydraulic flood routing is used in such cases. The developed operational flood routing stochastic model can be calibrated with data from a very short period of time and successfully overcomes the hydraulic flood routing application difficulties. There are some limitations on the use of the model, such as when the flow velocity is needed, or there is no outflow information. The successful application of the model to several natural streams in Greece has shown its validity for the design and operation of hydroelectric plants. (Baker-IVI)
W84-02993

GRAVITY WASTEWATER COLLECTION SYSTEMS OPTIMIZATION,
Indian Inst. of Tech., Bombay.
For primary bibliographic entry see Field 5B.
W84-03092

SHORT-TERM CLIMATE PREDICTIONS FOR WATER MANAGEMENT,
California State Dept. of Water Resources, Diamond Springs.
C. A. McCullough.
Bulletin of the American Meteorological Society, Vol. 64, No. 11, p 1273-1275, November, 1983.

Descriptors: *Short-term planning, *Climate, *Prediction, *Water management, Management planning, Forecasting, Water supply, Flood control, Reservoir releases.

Short-term climate predictions (two weeks to two years) have many applications to operation of water supply and flood control facilities. They influence use of water for irrigation, hydroelectric power production, flood control operation, recreational use of reservoirs, and numerous related water operations. The climate predictions now available have some limited usefulness. Those given an average skill factor of 65% can influence water management decisions. Short-term climatic predictions will be particulatly useful to operators of large water projects who must often base decisions for reservoir releases on expected weather conditions over the next 15-30 days. (Murphy-IVI)
W84-03156

EVAPORATION FROM SCREENED CLASS A PANS IN A SEMI-ARID CLIMATE,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 2D.
W84-03207

INTERPOLATION OF SHORT DURATION RAINFALL FROM 24-HOUR RAINFALL IN LOWER GODAVARI BASIN,
Meteorological Office, New Delhi (India).
For primary bibliographic entry see Field 2B.
W84-03307

THE KERNEL FUNCTION FOR WATERSHED RUNOFF MODELING,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 2E.
W84-03335

URBAN DESIGN-STORM SENSITIVITY AND RELIABILITY,
Prickett (Thomas A.) and Associates, Urbana, IL.
M. L. Voorhees, and H. G. Wenzel, Jr.
Journal of Hydrology, Vol. 68, p 39-60, 1984. 12 Fig, 5 Tab, 25 Ref. OWRT project A-095-ILL.

Descriptors: *Urban runoff, *Design storms, *Sensitivity, *Reliability, Computer models, Digital computers, Soil water, Model studies.

Urban-runoff design-storm selection has in the past been arbitrary at times, leading to inadequate and unreliable capacity design of urban-runoff structures. By utilizing a continuous urban-runoff digital computer model, the frequency response of selected urban basins to a selected historical point-rainfall record is generated. The model evaluates the sensitivity of the frequency response to design-storm parameters and antecedent soil moisture. This frequency response is used as a criterion for the selection of design storms. Sensitivity was exhibited by all the design-storm elements, confirming the feasibility of design storm reliability analysis Expectation analysis is applied to obtain estimates of reliable design storms. Expectation analysis yields reliable design storms. Application of expectation analysis to a two-parameter design-storm model is one practical recommendation. (Murphy-IVI)
W84-03336

ESTIMATING RESIDENTIAL FLOOD CONTROL BENEFITS USING IMPLICIT PRICE EQUATIONS,
Union Pacific Railroad, Omaha, NE.
E. Thompson, and H. H. Stoevener.
Water Resources Bulletin, Vol. 19, No. 6, p 889-895, December, 1983. 2 Tab, 10 Ref.

Descriptors: *Flood control, *Economic factors, Model studies, Mathematical equations, Land appraisals.

Estimating the value of changes in the quality of the environment has proven to be a difficult task. Public good characteristics typical of environmental attributes, such as the quality of the air, preclude the development of markets for these attributes. Without market transactions the economic value of environmental amenities cannot be observed directly. The application of implicit price equations to estimate the benefits from changes in the level of price determining characteristics such as air quality are numerous. However, empirical studies of flood control induced benefits are rare. An implicit price model relating residential lot value to price determining characteristics of land can measure the benefits of a structural flood control project. Special attention is given to the selection of relevant price determining characteristics of residential lots. An implicit price equation is estimated for both the with and without project conditions. Flood damages are quantified through the use of a dummy variable indicating a flood plain location. The analysis shows that annual flood damages were reduced by $15,275. Regression analysis results indicate that residential lots exposed to the flood hazards of Sutherlin Creek are valued less than lots not exposed to the threat of flooding. The value differential reflects the discounted value of expected damages associated with an unprotected flood plain location. Alternatively, it reflects the benefits derived from flood control. (Murphy-IVI)
W84-03392

FLOOD ROUTING THROUGH A FLAT, COMPLEX FLOODPLAIN USING A ONE-DIMENSIONAL UNSTEADY FLOW COMPUTER PROGRAM,
Hydrologic Engineering Center, Davis, CA.
For primary bibliographic entry see Field 8B.
W84-03395

ENVIRONMENTAL ASPECTS OF CLEARING AND SNAGGING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W84-03473

4B. Groundwater Management

GROUNDWATER MONITORING WELL PRIMER,
Hart (Fred C.) Associates, Inc., Newark, NJ.
P. Franconeri.
Pollution Engineering, Vol. 15, No. 8, p 24-26, August, 1983. 2 Fig.

Descriptors: *Monitoring, *Groundwater pollution, Water quality control, Groundwater protection, Water supply, Drinking water, Wells, Monitoring wells.

Installation of monitoring wells at a hazardous waste site is an important element in a groundwater investigation. A step-by-step description is presented for engineers involved with hazardous waste management. A flow chart is provided of the steps typically required to install groundwater monitoring wells at such a site. Information is provided on the following aspects of the job: well logs, site visit, well design, specifications, safety requirements, bidding, contract award, permits and clearances, test borings, well installation and well location. (Baker-IVI)
W84-03048

SUBSURFACE INJECTION OF TREATED SEWAGE INTO A SALINE-WATER AQUIFER AT ST. PETERSBURG, FLORIDA - AQUIFER PRESSURE BUILDUP,
Geological Survey, Tampa, FL.
For primary bibliographic entry see Field 5D.
W84-03078

MICROCOMPUTER MODEL OF ARTIFICIAL RECHARGE USING GLOVER'S SOLUTION,
D. Molden, D. K. Sunada, and J. W. Warner.
Ground Water, Vol. 22, No. 1, p 73-79, January-February, 1984. 12 Fig, 9 Ref. Office of Water Resources Technology and Colorado State University Experiment Station project 1-51101.

Descriptors: *Computer models, *Artificial recharge, Discharge measurement, Groundwater recharge, Computer programs, Groundwater mounding.

An interactive program written for an APPLE II 48 microcomputer provides an analytical solution for recharge from a rectangular basin. R. E. Grover published in 1960 through the USDA Agricultural Research Service in Ft. Collins, Colorado, a paper offering a solution to mathematical derivations in groundwater recharge. This microcomputer model written in BASIC adapts Glover's solution to computerized application. The model is capable of graphically displaying the rise and decline of the recharge mound for either an infinite homogeneous medium or for a stream aquifer system. Using this program a large number of recharge strategies can be graphically worked out by hydrologists, including soil parameters and characteristics, plus unusual boundary conditions. (Wheatley-IVI)
W84-03081

GROUND-WATER MOUNDING BENEATH A LARGE LEACHING BED,
Ontario Hydro, Toronto.
H. T. Chan, and J. F. Sykes.

Ground Water, Vol. 22, No. 1, P 86-93, January-February, 1984. 9 Fig, 17 Ref.

Descriptors: *Groundwater mounding, *Groundwater recharge, *Water level fluctuations, *Artificial recharge, Infiltration, Ontario, Norwood, Leaching, Mathematical models, Hydraulic loading.

An 84 m (276 ft) by 64 m (205 ft) experimental leaching bed was constructed to receive the secondary effluent from the Norwood, Ontario sewage treatment plant. The distribution system consisted of 100 mm diameter perforated pipes laid 2.1 m apart in 0.45 m wide trenches. The main soil layer at the test site was sandy silt. Ground-water levels at the site were measured approximately weekly at 36 piezometers for a period of about 2 1/2 years. An initial hydraulic loading of 122,700 l/day caused surface ponding. A reduced loading of 40,900 l/day was then used for most of the study period. Ground-water level fluctuations beneath and adjacent to the leaching bed were attributed to seasonally varying infiltration and hydraulic loading. The experimental data were simulated using a transient two-dimensional, phreatic integrated depth finite-element model and an analytic solution for ground-water mounding. Results from the study indicated that seasonal infiltration was a controlling factor in determining leaching bed design loads. Both mathematical models were found adequate for design. (Author's abstract)
W84-03083

PRELIMINARY STUDY OF THE DIVERSION OF 283 CU M/S (10,000 CFS) FROM LAKE SUPERIOR TO THE MISSOURI RIVER BASIN,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. W. Bulkley, S. J. Wright, and D. Wright.
Journal of Hydrology, Vol. 68, p 461-472, 1984. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Baseline studies, *Diversion, *Lake Superior, *Missouri River Basin, Groundwater depletion, Groundwater recharge, Diversion channels, Diversion structures, Economic aspects, Recharge Basins, Ogallala aquifer, Static head.

Trans-basin diversion is an established practice in this country. The High Plains Study authorized by the U.S. Congress in 1976 examined large-scale intra-basin diversion to replenish the depleted groundwater resources of the Ogallala aquifer. A portion of this intra-basin diversion could come from the Missouri River basin. This is the preliminary engineering associated with a large-scale diversion of Lake Superior water out of the Great Lakes and into the Missouri River basin in order to replace intra-basin water diverted for recharge of the Ogallala aquifer. The magnitude of the diversion is 283 cu m/s (10,000 cfs). The first cost of the conveyance structure is estimated at US $19.6 billion. The total length is estimated at 984 km and the total static lift including friction losses, static head, and pumping plant losses is 1130 m. An estimated 18 pumping plants will be required to lift the water from Lake Superior and transport it to the Missouri Basin. As estimated energy requirement to move this water is equivalent to the annual energy production from seven 1000-Mw plants. Initial costs of these power plants is estimated at $7 billion. (Murphy-IVI)
W84-03356

A LAND-USE POLICY BASED ON WATER SUPPLY,
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
For primary bibliographic entry see Field 6F.
W84-03398

ENGINEERING ECONOMIC ANALYSES OF ARTIFICIAL RECHARGE IN THE COLUMBIA BASIN PROJECT, WASHINGTON,
Geological Survey, Lakewood, CO.
M. R. Karlinger, and A. J. Hansen, Jr.
Water Resources Bulletin, Vol. 19, No. 6, p 967-975, December, 1983. 9 Fig, 4 Tab, 5 Ref, 1 Append.

Descriptors: *Artificial recharge, *Columbia Basin Project, *Washington, *Groundwater irrigation, Surface irrigation, Energy costs, Cost analysis, Water importing, Water conveyance, Water distribution.

Appraisal-level, engineering economic analyses for two types of irrigation systems are compared: a surface-water irrigation system, and a groundwater recharge irrigation system. The study area is in the southern part of the Columbia Basin Project, where development of irrigable land is in the planning stage. The proposed plan is to import water from Franklin D. Roosevelt Lake in northeastern Washington through an extension of the East Low Canal and to apportion the water to farm units using a lateral distribution system. An artificial recharge irrigation alternative would divert water from the lateral system and deliver it to recharge facilities, using the same supply facility and canal extension. The aquifer would then be used to convey water to individual agricultural units for irrigation pumping. An artificial recharge irrigation system is an economically viable alternative to surface-distributed irrigation in a conjunctive irrigation plan if electric power rates remain sufficiently low. As electric rates increase, this viability generally decreases until it becomes completely unattractive at rates of about $0.012/kwh. (Moore-IVI)
W84-03402

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF SURFACE MINING ON AQUATIC RESOURCES IN NORTH AMERICA,
For primary bibliographic entry see Field 5B.
W84-03197

4D. Watershed Protection

CROSS-COMPLIANCE TO ENFORCE SOIL AND WATER CONSERVATION,
Wisconsin Univ.-Madison. Dept. of Urban and Regional Planning.
J. I. K. Wildmann.
Journal of Soil and Water Conservation, Vol. 38, No. 2, p 75-78, March-April, 1983. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Erosion control, *Cross-compliance, Planning, Conservation, Soil conservation, Water conservation, Soil and Water Resources Conservation Act, Legislation, Government finance.

Among the strategies proposed in the Soil and Water Resources Conservation Act process was cross-compliance. This strategy would require that farmers carry out a program of soil and water conservation acceptable to the US Department of Agriculture in order to participate in USDA's commodity, loan, and insurance programs. Such a policy raises several conservation policy questions. The advantages of cross-compliance include the avoidance of practices that cause erosion and sedimentation, thus yielding increased soil conservation benefits for all. New cropping and tillage combinations include minimum tillage, residue management, lengthening and changing crop rotations, and changing the timing of cultivation. Alternative land treatment practices include contouring, stripcropping, and terracing. Some practical problems inherent in the cross-compliance scheme are discussed. (Baker-IVI)
W84-03053

WHAT IS CONSERVATION TILLAGE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. V. Mannering, and C. R. Fenster.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 140-143, May-June, 1983. 1 Fig, 5 Ref.

Descriptors: *Erosion control, *Soil conservation, Conservation tillage, Farming, Farm practices, Farm management, Tillage, Planning.

The suggestion is made that conservation tillage be used as an umbrella term, and that all tillage practices that conserve soil and water be listed under that term. Forms of row crop tillage include narrow strip tillage, no-tillage, strip rotary tillage, ridge planting, till-planting, full-width no-plow tillage, fall or spring chiseling, fall-spring disking, full-width plow tillage and wheel-tack planting. Forms of small grain tillage discussed include stirring and mixing machine tilling and stubble-mulch farming. People discussing conservation tillage are really talking about a system of farming. Equipment needs must be approached as a system based on soil and climatological conditions. The system must adequately control soil erosion, conserve moisture, and accommodate the crops grown. Weed, disease and insect control chemicals must be better understood. The fertility needs of crops grown with conservation tillage systems must be met efficiently. How conservation tillage affects labor and energy demands must be learned. (Baker-IVI)
W84-03058

CONSERVATION TILLAGE FOR EROSION CONTROL,
National Soil Erosion Lab., West Lafayette, IN.
W. C. Moldenhauer, G. W. Langdale, W. Frye, D. K. McCool, and R. I. Papendick.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 144-151, May-June, 1983. 4 Fig, 6 Tab, 25 Ref.

Descriptors: *Erosion control, *Soil conservation, Tillage, Farm management, Agriculture, Soil erosion, United States, Vegetation, Vegetation effects.

A region-by-region assessment is given of conservation tillage's effectiveness in controlling soil loss. In 1981 conservation tillage was used on one-third of the harvested cropland in the Corn Belt. The percentage of cropland in no-till was near the national figure of 2.5%. In the Corn Belt reduction of erosion seems to be a matter of leaving sufficient residue on the surface. In the Southeast it is important to break up the pan that forms each year in soil that is moldboard-plowed or even disked. Chiselling in the row breaks up the pan and allows moisture to get into the root zone, reducing runoff and erosion. In the Great Plains wind erosion is generally more serious than water erosion. Living or dead vegetation, again, is more effective than surface roughness in reducing erosion. Vegetation lifts the wind and also increases the percentage of nonerodible aggregates in conservation tillage practices. In the Pacific Northwest, growing vegetation effectively reduces erosion once the vegetation is established. No-tillage seeding of wheat has proved successful in reducing erosion, though under deep frozen soil conditions it may not reduce runoff. Surface roughness and surface residue prevent a continuous frost layer under shallow frozen soil conditions and help to reduce runoff. (Baker-IVI)
W84-03059

WATER QUALITY CONSEQUENCES OF CONSERVATION TILLAGE,
Iowa State Univ., Ames.
J. L. Baker, and J. M. Laflen.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 186-193, May-June, 1983. 4 Tab, 53 Ref.

Descriptors: *Water quality, *Water pollution sources, *Conservation tillage, Tillage, Erosion control, Soil conservation, Farm management, Vegetation, Agriculture, Runoff, Agricultural chemicals, Pesticides, Fertilizers.

Conservation tillage, which leaves some of all of the residue from the previous crop on the soil surface, effectively protects the soil against erosion. However, in order to maintain crop residues on the soil surface the use of fertilizers and pesticides is somewhat limited, affecting chemical concentrations and losses in surface water and sediment. Crop residue on the soil surface reduces runoff from all storms and eliminates runoff from most small storms. The slight to moderate reduction in runoff expected with conservation tillage

ystems will not alone have large impacts on the quality of receiving waters relative to chemicals ost in surface runoff. Of more importance in improving water quality is the soil conservation potential of conservation tillage and its impact on chemical losses with sediment. What impact conservation tillage has on chemical concentrations in runoff relates to the placement of agricultural chemicals during application and to the impact of conservation tillage on infiltration and runoff, particularly during the first storm after application, when most soluble losses occur. (Baker-IVI)
W84-03060

IRRIGATION + DRYLAND FARMING + LIMITED TILLAGE: A PROFITABLE COMBINATION,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
A. F. Wiese, and P. W. Unger.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 233-236, May-June, 1983. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Erosion control, *Irrigation practices, *Crop yield, Economic aspects, Agriculture, Irrigation, Water conservation, Soil conservation.

Current research has produced new insights into methods of combining limited irrigation, dryland farming, and limited tillage into profitable conservation farming systems for the 1980s. Attempts have been made to exploit the advantage of mulch on the soil surface in the Southern High Plains. Because soil water storage and crop yields increased with an irrigated straw mulch and because not enough mulch could be grown under dryland farming conditions, it seemed logical that by alternating irrigated and dryland cropping, dryland crops could be forced to yield more. Several advantages have been noted through several studies performed in the Southern High Plains. Because of increased soil water storage, dryland crop yields not only increased, but crop failures were less frequent. Increased yields and lower production costs increased the profits. Finally, high levels of crop residue on the soil surface greatly reduced the threat of soil erosion by wind and water. (Baker-IVI)
W84-03061

SOIL AND NUTRIENT RUNOFF LOSSES WITH IN-ROW, CHISEL-PLANTED SOYBEANS,
Agricultural Research Service, Watkinsville, GA.
For primary bibliographic entry see Field 2J.
W84-03062

RESIDUE MANAGEMENT AND CULTURAL PRACTICES FOR A SEMIARID REGION,
Agricultural Research Service, Big Spring, TX.
For primary bibliographic entry see Field 3F.
W84-03063

LONG-TERM ANNUAL RUNOFF AND SOIL LOSS FROM CONVENTIONAL AND CONSERVATION TILLAGE OF CORN,
Agricultural Research Service, Columbia, MO.
R. E. Burwell, and L. A. Kramer.
Journal of Soil and Water Conservation, Vol. 38, No. 3, p 315-319, May-June, 1983. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil conservation, *Tillage, Runoff, Erosion control, Erosion, Missouri, Claypan, Soil loss, Corn, Farm management.

Conservationists recognize that maximum average soil loss rates that would permit maintenance of crop production need to be specified for conservation system design. A central Missouri claypan soil had runoff and soil loss for conservation tillage 85 and 42%, respectively, of that for conventional tillage. Annual soil loss was 54 and 63% of the average annual predicted soil loss for conventional and conservation tillage, respectively. Runoff for corn after corn using conservation tillage was 13% less than that for conventional tillage. Soil loss for corn after corn using conservation tillage was 58% less than that for conventional tillage. Average annual soil losses for both tillage treatments on a 27.4 m long slope were less than the T-value of 6.7 metric tons per hectare per year currently used in conservation planning. (Murphy-IVI)
W84-03064

RESIDUE MANAGEMENT TO REDUCE FURROW EROSION,
Agricultural Research Service, Prosser, WA. Irrigated Agriculture Research and Extension Center.
D. E. Miller, and J. S. Aarstad.
Journal of Soil and Water Conservation, Vol. 38, No. 4, p 366-370, July-August, 1983. 1 Fig, 7 Tab, 15 Ref.

Descriptors: *Erosion control, *Irrigation practices, Soil conservation, Water conservation, Tillage, Herbicides, Turbidity, Runoff, Erosion.

Proper use of crop residue is the most powerful tool available for reducing runoff, erosion and sedimentation. Controlled streams applied to irrigation furrows containing various amounts of plant residue controls erosion and reduces turbidity of runoff water. Nonuniformity of infiltration rates pose a problem along a furrow. The use of surge furrow inflow in combination with furrow residue to control erosion may improve infiltration uniformity. Relatively small amounts of residue effectively reduce erosion. Thus, limited tillage to prepare a seedbed and incorporate herbicides is possible, while leaving adequate residue in the furrows to control erosion. (Murphy-IVI)
W84-03065

SOIL CONSERVATION STRATEGIES IN THE THIRD WORLD,
National Coll. of Agricultural Engineering, Silsoe (England).
N. W. Hudson.
Journal of Soil and Water Conservation, Vol. 38, No. 6, p 446-450, November/December, 1983. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Soil conservation, *Developing countries, Water supply, Water conservation, Agriculture, Farming, Conservation, Soil erosion, Erosion control.

Third World countries are facing tough problems in the area of soil conservation that require different solutions than do problems in developed countries. An approximate picture of the erosivity of rainfall can be gathered from data sources around the world. But the data is far from complete in the region of the Third World countries. It is even more difficult to produce a worldwide comparative study of erodibility because of the lack of a universally applicable index of erodibility of the soil. The risk of high soil loss from steep land is compounded by inappropriate use of the land. Non-technical problems encountered in the developing nations include political problems, reserved land, legislation, social features, fragmentation, a social significance attached to cattle, and the reluctance to move. (Baker-IVI)
W84-03068

RUNOFF CURVE NUMBERS FOR CONSERVATION TILLAGE,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. J. Rawls, and H. H. Richardson.
Journal of Soil and Water Conservation, Vol. 38, No. 6, p 494-496, November/December, 1983. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Soil conservation, *Erosion control, Conservation tillage, Tillage, Conservation, Water conservation, Erosion, Runoff velocity, Runoff.

Conservation tillage effects on runoff vary. A new set of Soil Conservation Service runoff curve numbers reflect these effects, based on residue cover. The relative effectiveness of conservation tillage practices in controlling runoff depends on how much runoff velocity is reduced, how much surface storage is increased, how much conductivity and moisture storage is increased, and how much raindrop impact is reduced. The SCS procedure for predicting runoff uses total-event rainfall. The amount of residue left on the soil surface or the percentage of the soil surface covered by residue indicates the effectiveness of conservation tillage practices in reducing runoff. Conservation tillage causes a decline of 1 to 4 runoff curve numbers, translating into a reduction in runoff from 9 to 16% associated with fallow land in good hydrologic conditions. The 9% reduction is associated with small grain, contoured and terraced with a good hydrologic condition. (Baker-IVI)
W84-03069

FIELD VERIFICATION OF RUNOFF CURVE NUMBERS FOR FALLOW ROTATIONS,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W84-03070

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: AN ANALYSIS OF BENEFITS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6B.
W84-03071

EVALUATING RIPRAPPING AND OTHER STREAMBANK STABILIZATION TECHNIQUES,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
J. R. McBride, and J. Strahan.
California Agriculture, Vol. 37, No. 5 and 6, May-June, 1983. 8 Fig.

Descriptors: *Bank stabilization, *Erosion control, Streams, Stream stabilization, Dry Creek, California, Sonoma County, Warm Springs, Russian River.

Stabilization of streambanks along creeks and rivers throughout Califonia is an important means of protecting agricultural land from erosion. Bank stabilization treatments have been installed in various locations along Dry Creek, primarily at meanders to absorb the erosional energy of the stream, deflect the current or both. The 14 mile long lower section of the creek, from Warm Springs Dam to the Russian River in Sonoma County was studied. Both the stabilization technique used and the harshness of the site determine the success of establishment. Bank stabilization with car bodies, wire fencing, and willow planting have not prevented the establishment of native riparian woodland species along Dry Creek. Wood fencing and the use of concrete rubble have led to the establishment of willow types without further successional development so far. Tire and rock riprapping and bamboo planting, however, have not provided environments where native riparian species can become established. Factors found to influence the establishment potential on stabilized areas include the erosional environment, available soil moisture, light, competition, position of the bank, and flow velocity. (Baker-IVI)
W84-03220

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

TOC DETERMINATIONS IN GROUND WATER,
Illinois State Water Survey Div., Champaign.
M. J. Barcelona.
Ground Water, Vol. 22, No. 1, p 18-14, January-February, 1984. 1 Fig, 4 Tab, 26 Ref.

Descriptors: *Organic carbon, *Groundwater pollution, *Pollutant identification, Chemical analysis, Volatile solids, Organic compounds, Monitoring.

Determinations of total organic carbon (TOC) can provide valuable diagnostic evidence of the extent of ground-water contamination by organic compounds. The usefulness of conventional TOC results in monitoring efforts is limited by the bias introduced during the purging of inorganic carbon prior to analysis. A modified TOC procedure permits the quantitation of the volatile organic carbon (VOC) fraction in water samples. The methodology consists of trapping the VOC in a manner analogous to commercial purge and trap instruments which are used for specific organic compound separations. The method is sensitive, accurate and reasonably precise for TOC determinations of standard solutions as well as on groundwater samples. Volatile organic carbon levels can range from 9-50% of the TOC in both uncontaminated and contaminated ground waters. The reporting of the volatile and nonvolatile fractions of the TOC will enhance both monitoring and research efforts, since it permits more complete characterization of the organic carbon content of groundwater samples. (Murphy-IVI)
W84-03074

RELATIONSHIPS BETWEEN GROUNDWATER SILICA, TOTAL DISSOLVED SOLIDS, AND SPECIFIC ELECTRICAL CONDUCTIVITY,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
B. A. Day, and H. I. Nightingale.
Ground Water, Vol. 22, No. 1, p 80-85, January-February, 1984. 4 Fig, 6 Tab, 19 Ref.

Descriptors: *Conductivity, *Groundwater, *Water quality, *Dissolved solids, *Silica, California, Fresno, San Joaquin Valley.

Specific electrical conductivity (SEC), total dissolved solids (TDS), and silica (SiO2) are groundwater quality parameters routinely measured in a laboratory. Electrical conductivity measurements are made quickly and are less costly than TDS measurements. Once the relationship between the parameters is determined by regression analysis, TDS can be estimated quickly from the SEC and SiO2 measurements. Water quality data from 25 city wells in Fresno, California, and historical ground-water quality data from the adjacent San Joaquin River/Kings River alluvial interfan (central San Joaquin Valley, California), the Kaweah River alluvial fan, and the Kern River alluvial fan (southern San Joaquin Valley) were used in this investigation. For the specific hydrologic areas studied, the model's TDS predictive ability is improved when SiO2 is included with SEC as the independent variables. (Author's abstract)
W84-03082

LONGITUDINAL DISPERSION IN NATURAL STREAMS,
Natural Systems Research, Hawthorn (Australia).
T. Beer, and P. C. Young.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1049-1067, October, 1983. 6 Fig, 48 Ref.

Descriptors: *Longitudinal dispersion, *Natural streams, Time series analysis, Pollution load, Comparison studies, Fikian model.

When time-series methods of parameter estimation are used to model the concentration of a pollutant in a natural waterway, the results may be grouped into a restricted class of models which are termed (j,n,m) models. The dispersion, as represented in conservative forms of these models, has a temporal variance that increases linearly with time (thus mimicking the variance of a Fickian process) and is consistent with dead zone mixing within rivers and streams. A variety of rivers demonstrate that the (j,n,m) model provides an explanation of actual data that is superior to those obtained by manipulation of a Fickian equation. In addition, the model greatly simplifies computation of dead zone dispersive effects, is able to simply deal with non-conservative pollutants and the results suggest that residence times are more meaningful physical parameters than dispersion coefficients in explaining dispersive phenomena. (Murphy-IVI)
W84-03087

COMPARISON OF BASIN PERFORMANCE MODELING TECHNIQUES,
Espey, Huston and Associates, Inc., Austin, TX. Environmental Engineering Div.
G. F. Goforth, J. P. Heaney, and W. C. Huber.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1082-1098, October, 1983. 10 Fig, 6 Tab, 10 Ref.

Descriptors: *Comparison studies, *Basins, *Performance evaluation, *Model testing, Water pollution control, Storm water, Water management, Runoff volume, Stormwater detention basins, Drawdown, Drainage area.

Combined and separate storm sewer overflows contribute similar magnitudes of contaminant loads to receiving waters as does secondary treatment effluent. A comparison of methods used for analyzing the long-term pollutant removal efficiency in a stormwater detention basin points out some fundamental differences between simulation, using EPA's Storm Water Management Model, and a statistical technique advanced by Hydroscience, Inc. For the 24.6-yr record of Atlanta, Georgia hourly rainfall, the mean runoff event volume predicted by each method is similar. However, the inability of the statistical method to account for the reduction in the number of events (due to indigenous catchment storage) results in an estimate of total runoff 30% greater than the simulation results. The statistical technique employs a pollutant removal expression applied to the total flow captured in the detention basin, as contrasted to the simulation utilization of intra-event pollutant kinetics for removal within the basin. Solution surfaces of runoff flow capture and pollutant removal efficiencies are developed for each method as a function of basin volume and drawdown rate. The differences in performance estimates between the two methods increase as the basin volume and drawdown rate increase, with the statistical technique yielding the lower estimate of flow capture. For a long-term pollutant removal efficiency of 70%, the annual cost associated with a basin designed by the statistical technique is approximately twice that of a basin designed by simulation. The program SYNOP generates rainfall event statistics which may be incorporated with simulation, providing a coordinated approach for analyzing the performance of stormwater detention basins. (Murphy-IVI)
W84-03088

SPECTROPHOTOMETRIC DETERMINATION OF NITRITE IN NATURAL WATERS BY FLOW INJECTION ANALYSIS,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, M. Yagi, M. Zenki, A. Takahashi, and K. Toei.
Analytica Chimica Acta, Vol. 155, p 263-268, December, 1983. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Nitrite, *Pollutant identification, Water analysis, Spectrophotometry, Flow injection, Natural waters, Lakes, Ponds, Irrigation water, Rain water, Well water.

Rapid, sensitive, and accurate methods of determining nitrite in natural waters are essential in environmental chemistry, geochemistry and limnology. This method is suitable for the determination of low microgram/liter levels of nitrite in waters. Nitrite diazotizes p-aminoacetophenone and the product is coupled with m-phenylenediamine at 30 degerees C. The limit of detection is 0.2 micrograms/liter for sample injections of 650 microliters. The sampling rate is about 30/hr and the relative standard deviation is less than 1.3%. This method was successful in determining nitrite at low micrograms per liter levels in natural waters taken from rivers, lakes, ponds, and wells as well as rain water and irrigation water samples. (Murphy-IVI)
W84-03109

ROUND ROBIN INVESTIGATION OF METHODS FOR THE RECOVERY OF POLIOVIRUS FROM DRINKING WATER,
Baylor Coll. of Medicine, Houston, TX.
J. L. Melnick, R. Safferman, V. C. Rao, S. Goyal, and G. Berg.
Applied and Environmental Microbiology, Vo 47, No. 1, p 144-150, January, 1984. 6 Tab, 30 Re

Descriptors: *Experimental design, *Poliovirus *Potable water, Water quality control, Water qua ity, Water analysis, Hydrologic data collection Adsorption, Viradel-organic flocculation, Filter Filtration.

Six laboratories actively involved in water virolo gy research participated in a methods evaluatio study, conducted under the auspices of the Ameri can Society for Testing and Materials Committe on Viruses in the Aquatic Environment, Tas Force on Drinking Water. Each laboratory exam ined the Viradel (virus adsorption-elution) metho with cartridge-type Filterite filters for virus ad sorption and organic flocculation and aluminum hydroxide-hydroextraction for reconcentration The quantity of virus recovered from four 100-lite samples of dechlorinated tapwater seeded with lov (350 to 860 PFU) and high (1,837 to 4,689 PFU doses of poliovirus type 1, were in considerabl variation. The Viradel-organic flocculatio method had an average percentage virus recover for low-input experiments of 66%, with a range o 8 to 20% in two laboratories, 49 to 63% in thre laboratories, and 198% in one laboratory. For th high-input experiments, two laboratories had re coveries of 6 to 12%, and four laboratories had recoveries of 26 to 46%. For the Viradel aluminum hydroxide-hydroextraction procedure, two labora tories recovered 9 to 11%, whereas four obtained 17 to 34% for low-input experiments. For the high input tests, two laboratories had a recovery of 3 t 5%, and four recovered 11 to 18% of the seeded virus. Each laboratory was also encouraged to tes other methods reported to be useful and reliable but which had not been widely used. Other meth ods tested such as magnetic iron oxide, 'Virozorb electropositive filters, Virozorb filters in combina tion with membrane filters, and membrane disks alone, had average virus recoveries of 36, 20, 0.4 and 5%, respectively. Possible differences in qual ity of the water in which the virus was diluted and in the quality of the eluents are some of the varia bles suspected for the wide differences in virus recovery results from different laboratories. Nev ertheless, there was sufficient consistency among four of the six laboratories for the task force to recommend the Viradel-organic flocculation pro cedure as a provisional method for the recovery of human enteroviruses from drinking water. (Murphy-IVI)
W84-03110

A COLUMN TECHNIQUE FOR DETERMINING SORPTION OF ORGANIC SOLUTES ON THE LITHOLOGICAL STRUCTURE OF AQUIFERS,
Geological Survey, Menlo Park, CA.
D. F. Goerlitz.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 1, p 37-44, January, 1984. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Organic compounds, *Aquifers, *Pollutant identification, Contaminants, Chromatography, Groundwater pollution.

It is estimated that presently some 6.5 billion cubic meters of contaminated liquids infiltrate our ground water each year. Waste dumps and chemical impoundments are primary contributors to the contamination. There are apparent problems in the batch sorption determination and uncertainties in the indirect octanol-water partition, organic-carbon method. Alternative sediment-column technique uses readily available high performance liquid chromatography equipment thus permitting automation of the elution and effluent monitoring. This method was convenient, reproducible, and closely resembles ground water-transport mechanism. The sorption behavior of organic solutes in aquifer material was readily determined by evaluation of the elution histories of sediment columns. The heretofore difficult technique has been made practical through the use of high pressure liquid

hromatography technology. The ability to select solution concentration of column to the sediment est column permits wide flexibility for evaluation. The need for a minimum amount of attention uring the experiment is also a valuable feature of his technique. (Murphy-IVI)
V84-03129

BAKER'S YEAST ASSAY PROCEDURE FOR TESTING HEAVY METAL TOXICITY,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
G. Bitton, B. Koopman, and H. D. Wang.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 1, p 80-84, January, 1984. Fig, 2 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Water analysis, Yeast, Cultures, Heavy metals, Copper, Zinc, Mercury, Nickel, Silver, Metals.

As a result of the entry of thousands of chemicals into the aquatic environment, there is a need for rapid screening of chemical toxicity. A toxicity assay for heavy metals using commercial dry yeast as the test microorganism was most sensitive for copper and was intermediate in sensitivity for mercury, zinc, and nickel. Only in the case of mercury was the sensitivity of the bakers' yeast assay procedure less than 40% that of the most sensitive alternative toxicity assay. Bakers' yeast is readily available from commercial sources, is inexpensive and stable at room temperature for long periods. No tedious and time consuming culture technqiues are needed. The cells can be easily observed using a low cost compound microscope. (Murphy-IVI)
W84-03131

DETERMINATION OF CHLORINE DIOXIDE, CHLORINE, CHLORITE AND CHLORATE IN WATER,
Stanford Univ., CA. Dept. of Civil Engineering.
E. M. Aieta, P. V. Roberts, and M. Hernandez.
Journal of American Water Works Association, Vol. 76, No. 1, January, 1984. 7 Tab, 24 Ref. EPA grant R-808686.

Descriptors: *Pollutant identification, *Monitoring, Wastewater treatment, Chlorine, Chlorine dioxide, Chlorite, Chlorate, Drinking water, Disinfection, Water treatment, Titration, Potentiometry, Amperometry.

Chlorine dioxide is an attractive alternative for chlorine in drinking water disinfection, because it effectively inactivates bacteria and viruses over a broad pH range, does not produce trihalomethanes and provides a measurable residual. A procedure herein which is used for either amperometric or potentiometric determination of iodine is formed by the oxidation of iodide by chlorine dioxide, chlorine, chlorite, and chlorate. Either phenylarsine oxide or sodium thiosulfate can be used as the titrant. Sample pretreatment and pH adjustment differentiate among the various chlorine species. The method can be adapted to characterize either feed and product streams of chlorine dioxide generators (typical concentration range of individual species: 10-1000 mg/L) or treated drinking water (typical concentration range: 0.1-1 mg/L). The detection limits in drinking water are felt to be about 0.05, 0.02, 0.02, and 0.25 mg/L for chlorine dioxide, chlorine, chlorite, and chlorate, respectively. The sensitivity and precision represent a substantial improvement over other methods in use. In the high concentration range precision was good. In the low concentration range the method should prove helpful in monitoring the dosage of chlorine dioxide and in studying the transformations of oxidized chlorine species in treated waters and distribution systems. (Murphy-IVI)
W84-03141

RECULTIVATION OF LAKE MUTEK - ENVIRONMENTAL AND FISHERY ASPECTS,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
J. A. Szczerbowski, K. Lossow, H. Gawronska, S. Niewolak, and J. Sosnowska.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 2, p 103-140, 1983. 17 Fig, 6 Tab, 82 Ref.

Descriptors: *Lake Mutek, *Poland, *Environmental effects, *Lake fisheries, *Aeration, *Lake restoration, Chemical properties, Microorganisms, Phytoplankton, Macrophytes, Zooplankton, Benthic fauna, Aquatic environment.

Lake aeration and intensive fishery management allowed for better and more effective utilization of the existing production potential. The aeration process at Lake Mutek (1977-1980) prevented formation of the thermocline and increased temperature of over-bottom water layers to about 17 C. Lake aeration induced only slight changes in the sediments from shallow lake areas, accelerating processes of mineralization. The number of phytoplankton species decreased during aeration, while phytoplankton biomass doubled in 1978, increased four-fold in 1979, but decreased in the last year to levels lower than in the control year. The biomass of emerged and submerged vegetation increased by about 25%. The annual biomass of planktonic crustaceans almost doubled, and the vertical range of zooplankton occurrence became wider. The density and biomass of bottom fauna in the littoral and sublittoral zone noticeably increased, but in the profundal zone they decreased. Aeration, as a method of lake recultivation, had an effect upon physical and chemical properties of water, microorganisms, phytoplankton, macrophytes, zooplankton, bottom fauna and fishes. (Murphy-IVI)
W84-03153

IDENTIFICATION AND DETERMINATION OF POLYCHLORINATED BIPHENYLS BY HIGH-RESOLUTION GAS CHROMATOGRAPHY,
National Water Research Inst., Burlington (Ontario). Analytical Methods Div.
F. I. Onuska, R. J. Kominar, and K. A. Terry.
Journal of Chromatography, Vol. 279, p 111-118, 1983. 3 Fig, 4 Tab, 11 Ref.

Descriptors: *Polychlorinated biphenyls, High-resolution gas chromatography, Computers, Chemical analysis, Water sampling, Pollutant identification, Sediments.

An integrated analytical procedure for polychlorinated biphenyl (PCB) multiresidues in sediment samples enables quantitation of PCB residues at levels as low as 0.1 microgram/kg in sediments. PCB residues are characterized and quantified by wall-coated open-tubular column gas chromatography with electron-capture detection. An automated data system, based on a Spectra Physics SP-4100 computing integrator, selects and quantitates peaks of individual isomers and homologous groups of PCBs. Interferences from the DDT group, organochlorine compounds and Mirex can easily be identified and subtracted from the chromatogram. The procedure consistently yields results with a reproducibility within 3%. (Murphy-IVI)
W84-03157

POSSIBILITIES AND LIMITATIONS OF TRACING INDUSTRIAL EFFLUENTS IN THE SEA BY MEANS OF CAPILLARY CHROMATOGRAPHY,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
B. Josefsson.
Journal of Chromatography, Vol. 279, p 119-123, 1983. 1 Fig, 13 Ref.

Descriptors: *Tracers, *Effluents, *Chromatography, *Industrial wastes, Capillary chromatography, Water analysis, Seawater, Chlorophenols, Halogenated hydrocarbons.

Certain organic constituents of waste water, such as halocarbons and chlorophenols, can be used to establish the distribution pattern of effluents discharged into the sea. The approach requires simple sampling techniques and highly sensitive and rapid analytical methods. The combination of glass capillary column gas chromatography and electron-capture-detection meets the analytical requirements. The selectivity of the detector, together with the high resolving power of the column, makes it possible to handle the complex sea-water matrix. Selective derivatization directly in the water sample is combined with simultaneous extraction to increase the number of suitable tracers. Halocarbons can be measured at pg/l levels. Chlorophenols are determined at ng/l concentration levels. (Author's abstract)
W84-03158

DIRECT DETERMINATION OF TRACE AMOUNTS OF CHLOROPHENOLS IN FRESH WATER, WASTE WATER AND SEA WATER,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
K. Abrahamsson, and T. M. Xie.
Journal of Chromatography, Vol. 279, p 199-208, 1983. 8 Fig, 2 Tab, 11 Ref.

Descriptors: *Chlorinated phenols, *Water analysis, *Wastewater analysis, *Seawater, Gas chromatography, Phenols, Pulp wastes, Drinking water, Acetylation.

Chlorophenols were acetylated and the derivatives extracted by the simultaneous addition of acetic anhydride and hexane directly to the water sample. The extracts were then analysed by glass capillary column gas chromatography with electron-capture detection. Determination of chlorinated phenols at micro g/l concentration levels requires only 5 ml of sample. At ng/l levels a 100-ml sample is sufficient. The total time of analysis is 18 min per sample. A comparison between pentafluorobenzoylation and acetylation showed that the acetylated derivatives of chlorophenol isomers separated better on the column. The method has been applied to drinking water, sea water and waste water from a sulfate pulp mill. (Author's abstract)
W84-03160

QUANTITATION OF ENVIRONMENTAL CONTAMINANTS BY FUSED-SILICA CAPILLARY COLUMN GAS CHROMATOGRAPHY-MASS SPECTROMETRY WITH MULTIPLE INTERNAL STANDARDS AND ON-COLUMN INJECTION,
Freshwater Fisheries Lab., Pitlochry (Scotland).
D. E. Wells, and A. A. Cowan.
Journal of Chromatography, Vol. 279, p 209-218, 1983. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Mass spectrometry, *Internal standards, Pesticides, Herbicides.

The on-column injector to the gas chromatographic-mass spectrometric (GC-MS) instrument had superior quantitative results when compared with the splitless injection, particularly for less volatile, non-polar herbicides and pesticides. The final sample solvent can be selected on the basis of the desired chromatographic separation to give shorter analysis times and minimal delay between injections. The precision in peak retention times and areas in markedly improved by the use of multiple internal standards, eluted within ten minutes of the analyte. Many of the internal standards selected may be used with GC-MS, gas chromatography-electron capture detection and high-performance liquid spectrometry with ultraviolet and fluorescence detection. (Murphy-IVI)
W84-03161

INVESTIGATION OF A COMPREHENSIVE APPROACH FOR TRACE ANALYSIS OF DISSOLVED ORGANIC SUBSTANCES IN WATER,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
M. Giabbai, L. Roland, M. Ghosal, J. H. Reuter, and E. S. K. Chian.
Journal of Chromatography, Vol. 279, p 373-382, 1983. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Organic compounds, *Water analysis, Drinking water, Natural waters, Trace substances, Adsorption, Gas chromatography, Hydrogen ion concentration.

An isolation-fractionation scheme for the analysis of dissolved trace organic substances in natural and drinking waters was developed. The principle behind this scheme was to concentrate dissolved organic solutes and separate them into fractions by adsorption on different adsorbents (XAD-8 resin, AG-MP-50 cation-exchange resin and Carbopack B graphitized carbon black) under varying pH conditions. Test solutions containing 22 model organic substances and inorganic salts were used to monitor process performance. High-resolution gas chromatography was employed for the separation and quantitation of each model compound. Chemical derivatization procedures were established for several highly polar model compounds. Gas chromatography-mass spectrometry was used for the confirmation of compound identity in each separated fraction. (Author's abstract)
W84-03162

EVALUATION OF SAMPLING METHODS FOR THE DETERMINATION OF TRACE ORGANICS IN WATER,
Alabama Univ., University. Dept. of Chemistry.
M. M. Thomason, and W. Bertsch.
Journal of Chromatography, Vol. 279, p 383-393, 1983. 5 Fig, 3 Tab, 27 Ref.

Descriptors: *Organic compounds, *Water analysis, *Gas-phase stripping, *Sampling, Solvents, Thermal desorption.

The applicability of a closed-loop gas-phase stripping apparatus for the determination of trace organics in water was evaluated. Recoveries were determined for a series of n-alkanes. The effects of extraction solvent, stripping temperature, stripping time, pH and salt content on the closed-loop system were investigated. Carbon disulfide was found to be the best extraction solvent, and an extraction temperature of 40 degrees C was found to be optimal. Two water samples spiked with 0.1-0.2 and 1.0-2.0 micro g/l of each U.S. Environmental Protection Agency base neutral priority pollutant were investigated. Recoveries for the base neutrals of the more concentrated sample were determined at 25 and 40 degrees C. A direct comparison of the closed-loop gas-phase stripping method and the purge-and-trap method with Tenax GC was performed on a river water sample. Recoveries for the thermal desorption of base neutrals from Tenax were determined at five different desorption temperatures. A new microextraction vessel, which allows the use of solvents heavier than water, was constructed and evaluated. Distribution coefficients and recoveries for compounds of different functionalities were determined at three different water to solvent ratios and at concentration levels of 100 ppb and 0.5 ppm. (Author's abstract)
W84-03163

RESEARCH IN ENVIRONMENTAL POLLUTION; I. DETERMINATION OF POLYCHLORINATED STYRENES (PCS'S) IN RHINE FISH,
Hessische Landwirtschaftliche Versuchsanstalt, Darmstadt (Germany, F.R.).
H. Steinwandter, and L. Zimmer.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 316, No. 7, p 705-710, December, 1983. 8 Fig, 7 Ref.

Descriptors: *Polychlorinated styrenes, *Rhine River, *Fish, *Pollutant identification, Polychlorinated biphenyls, Metabolism.

In chromatograms of extracts from fish from the Rhine River, in addition to chlorinated pesticides, the well know pattern of polychlorinated biphenyls can be seen. In the region of di-, tri- and tetrachlorobiphenyls the disappearance of certain polychlorinated biphenyl peaks indicates metabolic breakdown. The similarities between the ECD-chromatograms and HCB detect a very non-polar substance group to be present. By mass spectra and mass fragmentography the peaks were identified as polychlorinated styrene compounds. From 159 possible isomeric polychlorinated styrene compounds, 14 isomers were identified in fish. (Murphy-IVI)
W84-03189

BIOASSAYS WITH STIGEOCLONIUM KUTZ. (CHLOROPHYCEAE) TO IDENTIFY NITROGEN AND PHOSPHORUS LIMITATIONS,
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
P. J. R. De Vries, M. Torenbeek, and H. Hillebrand.
Aquatic Botany, Vol. 17, No. 2, p 95-106, October, 1983. 3 Fig, 2 Tab, 37 Ref.

Descriptors: *Bioassay, *Stigeoclonium, *Nitrogen, *Phosphorus, *Nutrients, Chlorophyta, Eutrophication, Water quality, Seasonal variation, Polders, Netherlands.

In polder ditches, which are a characteristic of the Netherlands, eutrophication often results in abundant growth of periphyton and aquatic macrophytes. These organisms are the main producers and provide an indication of the water quality. Primarily for this aquatic environment, a suitable bioassay organism is needed and periphytic filamentous algae may be a useful addition to the range of test algae. Eleven strains of the filamentous algae genus Stigeoclonium were tested as bioassay organisms to identify nitrogen and phosphorus limitations to growth in a variety of waters. The assay results were related to the nutrient status of the waters during the year. Optimal growth was obtained at an inorganic phosphorus concentration of 0.65 mg P/l and an inorganic nitrogen concentration of 3.75 mg N/l. The algal growth potentials were generally higher in November and February than in August. Nitrogen became important as a limiting nutrient in the summer. When ratios of inorganic nitrogen to inorganic phosphorus (N/P) were above 6.2, phosphorus was primarily limiting and at lower N/P ratios nitrogen became the important limiting factor. Stigeoclonium proved to be a suitable bioassay organism to identify nutrient limitation in shallow freshwaters. (Moore-IVI)
W84-03193

A HIGH-SPEED LIQUID CHROMATOGRAPHY OF PHOSPHORUS IN ANOXIC WATERS OCCURRING IN A BAY USING SOLVENT EXTRACTION OF MOLYBDOHETEROPOLY YELLOW,
Hamamatsu Univ. (Japan). Dept. of Chemistry.
N. Ichinose, C. Shimizu, H. Kurokura, and T. Inui.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 316, No. 8, p 791-792, 1983. 3 Tab, 4 Ref. Japanese Scientific Research grant 1-R16-2.

Descriptors: *Chromatography, *Pollutant identification, *Phosphorus, Molybdoheteropoly yellow, Anoxic conditions, Lakes.

The deepest bottom of brackish water in lake Hamana of Japan forms an ocean basin. In this area anoxic waters are occurring in the summer with appreciable elutions of dissolved inorganic phosphorus, dissolved organic phosphorus, ferrous and ferric iron, soluble silica, hydrogen sulphide and other substances from the sludge in this anoxic waters. The application of high-speed liquid chromatography method can be widely employed for the rapid determination of microamounts of phosphorus, without the interference of co-existing silica, in sea and river water as well as anoxic waters. The interference of co-existing soluble silica is effectively eliminated by an extraction step. Micro-amounts of phosphrous ranging from 0.015 to 0.2 ppm in the anoxic waters can be determined rapidly and exactly (coefficient of variation 4.4%). The results agreed well with those obtained by spectrophotometry. (Baker-IVI)
W84-03288

A SIMPLIFIED 1,10-PHENANTHROLINE TECHNIQUE SUITABLE FOR THE DETERMINATION OF DISSOLVED IRON IN REMOTE SOUCES OF WATER,
Njala Univ. Coll., Freetown (Sierra Leone). Analytical Lab.
R. C. Wright.
Freshwater Biology, Vol. 13, No. 3, p 293-296, June, 1983. 2 Tab, 4 Ref.

Descriptors: *Iron, *Pollutant identification, Water quality, Remote areas, Sampling.

When testing remote water sources for dissolved iron, the investigator must either use a field method or reserve a sample for subsequent laboratory determination. The latter may produce a significant alteration in the relative amounts of the different iron fractions which occur in most samples. A simplified 1,10-phenanthroline technique is useful for investigating remote sources and avoids errors due to post-sampling precipitation of hydrated ferric oxides. A small sample is added to a mixed 1,10-phenanthroline + acetate buffer solution in the field and this developed sample can then be stored for up to 4 weeks before the absorbance value is read. Average within batch precision of the technique was about 4%. Accuracy was good for streams and river samples, although a relatively large negative bias was noted for shallow-pond sample replicates. (Baker-IVI)
W84-03292

METALS IN THE PACIFIC SARGASSUM ALGAE AS RELATED TO WATER POLLUTION MONITORING (METALLY V SOSTAVE TIKHOOKEANSKIKH SARGASSOVYKH VODOROSLEI V SVYAZI S PROBLEMOI MONITORINGA EAGRYAENENIYA VOD),
N. K. Khristoforova, N. N. Bogdanova, and L. M. Tolstova.
Okeanologiia, Vol. 23, No. 2, p 270-275, March-April 1983. 2 Tab, 27 Ref.

Descriptors: *Sargassum, *Metals, *Monitoring, Water pollution effects, Marine algae, Iron, Manganese, Copper, Zinc, Lead, Cadmium, Pacific Ocean.

The concentrations of the metals Fe, Mn, Cu, Zn, Pb and Cd, in sargassum are discussed in connection with the intensity of anthropogenic loading on their habitats. According to the mineral composition of algae, the quality of coastal waters of some Pacific regions is characterized. It is shown that Mn concentration in the algae depends on the illumination conditions rather than on the environmental geochemical factors, and that sargassums seem to be capable of regulating the accumulation of this metal. (Author's abstract)
W84-03312

AUTOMATED RAIN SAMPLER FOR TRACE ORGANIC SUBSTANCES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
W. M. J. Strachan, and H. Huneault.
Environmental Science and Technology, Vol. 18, No. 2, p 127-130, February, 1984. 1 Fig, 2 Tab, 17 Ref. Department of Environment grant 9-904-EM-IWD.

Descriptors: *Measuring instruments, *Rainfall, *Organic compounds, Sampling, Water sampling, Polychlorinated biphenyls, Benzene hexachloride, Lindane, Chemistry of precipitation.

An automated rain sampler was designed, built, and evaluated as a collecting device for persistent organic chemicals in rain. It consists of a large Teflon-coated funnel (0.209 sq m) with an automated lid and a Teflon column containing XAD-2 and -7 resin. The sampler was tested for recoveries and field precision with a number of organochlorine substances and PCBs frequently found at the nanogram per liter level in rain. Recoveries averaged 86% and the mean coefficient of variation for alpha-benzene hexachloride, lindane, and polychlorinated biphenyl was 33% under field conditions where samples of 0.4-22 L of rain were collected. While few quality control studies have been attempted for this type of sampler, it is felt that these results are at least as good as those from any other technique. The sampler also offers the advantage of unattended operation for extended periods, and it provides a simple method for field handling of samples since the columns can be readily exchanged and capped for delivery. (Baker-IVI)
W84-03330

A MODEL OF THE DISPERSION OF SOLUBLE OF PSEUDO-SOLUBLE SUBSTANCES IN

WATERWAYS. APPLICATION TO THE CASE OF THE SEINE UPSTREAM OF PARIS (MODELISATION DE LA DISPERSION DES SUBSTANCES SOLUBLES OU PSEUDO-SOLUBLES DANS UN COURS D. EAU. APPLICATION AU CAS DE LA SEINE A L'AMONT DE PARIS),
Compagnie Generale des Eaux, Paris (France).
G. Bujon.
Houille Blanche, No. 1, p 45-53, 1983. 7 Fig, 4 Ref.

Descriptors: *Model studies, *Dispersants, *Solubility, *Waterways, *Seine River, Mathematical models, Mathematical studies, Simulation analysis, Pollution load, Flow characteristics.

Technicians working with water often have to anticipate changes in water quality at a given point in a waterway as a result of the permanent or temporary discharge of a polluting effluent upstream of this point. Since it is not generally possible to find a solution to this problem by experimental means (projections are often desired for low-level flow rates), it is necessary to resort to the use of mathematical simulation models, which are calibrated by means of a few preliminary experiments. The dispersion model is a bi-dimensional model established on the basis of the influence of the bands, a certain transverse variation in the field of flow speeds and the disappearance of part of the pollutant in the course of time. (Murphy-IVI)
W84-03358

APPLICATION OF ULTRACLEAN SAMPLING AND ANALYTICAL TECHNIQUES TO AN INVESTIGATION OF THE IMPACT OF POWER-PLANT DERIVED HEAVY METALS ON GROUNDWATER, RIVERWATER, BOTTOM SEDIMENTS AND BENTHIC ORGANISMS,
Connecticut Univ., Groton. Marine Sciences Inst.
D. G. Waslenchuk.
Water Science and Technology, Vol. 15, No. 11, p 223-237, 1983. 4 Fig, 8 Tab, 12 Ref.

Descriptors: *Sampling, *Ultraclean sampling, *Analytical techniques, *Powerplants, *Heavy metals, *Groundwater, *Riverwater, *Bottom fauna, Mathematical analysis, Ecological effects, Trace metals, Geochemistry, Effluents, Cooling water, Sample preparation.

At a Massachusetts power station, the routine trace metal analyses provided by private water-quality laboratories gave the impression that metal levels in stream and groundwaters adjacent to the plant were alarmingly high. The problem though is more perceived than real. Ultra-clean sampling and handling techniques from geochemical oceanographic practices, together with interpretive concepts from aquatic geochemistry had levels of metal enrichment in stream waters which were lower (eg. Cu, 2 ug/l) than implied by the evidently investigator-contaminated samples (eg. Cu, 20ug/l). Employing difficult but uncompromising procedures when dealing with metals in the aquatic environment is extremely important. With accurate analyses at hand, the geochemist's 'mixing diagram' concept allows interpretation of the fate of the power-plant derived excess metals in the cooling-water discharge. Excess dissolved copper disappeares due to simple and rapid dilution in the effluent river mixing zone. For bottom sediments from the adjacent Connecticut River natural processes largely explain the distribution of Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn associated with the acid leachable fraction of the sediments. No anomalous metal concentrations were among the sediments, but oligochaete worms living in the sediments beneath the cooling-water plume had accumulated more metal than those elsewhere. Because tissue metal levels were unrelated to sediment metal levels, the worms may respond more to the dissolved metal load than to the sediment burden. (Murphy-IVI)
W84-03380

RHODAMINE WT DYE LOSSES IN A MOUNTAIN STREAM ENVIRONMENT,
Geological Survey, Menlo Park, CA.
K. E. Bencala, R. E. Rathbun, A. P. Jackman, V. C. Kennedy, and G. W. Zellweger.
Water Resources Bulletin, Vol. 19, No. 6, p 943-950, December, 1983. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Tracers, *Dye releases, *Rhodamine dye, Mountain streams, Chloride, Lithium, Sorption, Streambeds, Gravel, Groundwater.

A significant fraction of rhodamine WT dye was lost during a short term multitracer injection experiment in a mountain stream environment. The conservative anion chloride and the sorbing cation lithium were concurrently injected. In-stream rhodamine WT concentrations were as low as 45% of that expected, based on chloride data. Concentration data were available from shallow 'wells' dug near the stream course and from a seep of suspected return flow. Both rhodamine WT dye and lithium were nonconservative with respect to the conservative chloride, with rhodamine WT dye closely following the behavior of the sorbing lithium. Nonsorption and sorption mechanisms for rhodamine WT loss in a mountain stream were evaluated in laboratory experiments. Experiments evaluating nonsorption losses indicated minimal losses by such mechanisms. Laboratory experiments using sand and gravel size streamed sediments show an appreciable capacity for rhodamine WT sorption. The detection of tracers in the shallow wells and seep indicates interaction between the stream and the flow in the surrounding subsurface, intergravel water, system. The injected tracers had ample opportunity for intimate contact with materials shown in the laboratory experiments to be potentially sorptive. It is suggested that in the study stream system, interaction with streambed gravel was a significant mechanisms for the attenuation of rhodamine WT dye (relative to chloride). (Author's abstract)
W84-03399

SEDIMENT SAMPLING IN DIFFERENT AQUATIC ENVIRONMENTS: STATISTICAL ASPECTS,
National Swedish Environment Protection Board, Solna.
L. Hakanson.
Water Resources Research, Vol. 20, No. 1, p 41-46, January, 1984. 3 Fig, 5 Tab, 26 Ref.

Descriptors: *Sediments, *Sampling, *Statistical analysis, Lake sediments, River sediments, Lead, Copper, Cadmium, Erosion, Sediment transport.

The study is based on empirical data from three different sedimentological environments: a river, a river mouth area, and a lake. The first two environments are dominated by processes of erosion and transportation; the latter milieu is characterized by continuous accumulation of fine materials. The empirical data emanates from a regular grid of nine sites 15 m apart from the three environments. The sediment were analyzed for physical sediment character (water content and loss on ignition) and chemical/contaminational status (Pb, Cu, and Cd). The prevalent bottom dynamics influence the character of the sediments and the representativity and information value of sediment samples. An informative fraction is defined by the portion of a sediment sample that passes a 63-micro m mesh by wet sieving. This fraction corresponds approximately to deposits from areas of accumulation. Direct analysis of surficial sediment samples from areas of erosion or transportation, such as in rivers and river mouths, yield low information, i.e., many samples would be required to obtain a given statistical certainty. Correction with the water content (or similar parameters, e.g. grain size and bulk density) or organic content would improve the information but still not yield optimal results. Simple wet sieving through a 63-micro m mesh seems to yield best information, i.e., the lowest number of necessary analysis for the least amount of work. Fractionated centrifugation (or similar approach, e.g., ultrafiltration) would not improve the information value. (Moore-IVI)
W84-03411

NONPARAMETRIC TESTS FOR TREND IN WATER QUALITY,
Washington Univ., Seattle.
G. van Belle, and J. P. Hughes.
Water Resources Research, Vol. 20, No. 1, p 127-136, January, 1984. 2 Fig, 5 Tab, 22 Ref, 1 Append.

Descriptors: *Water quality, *Trend, *Statistical analysis, *Nonparametric tests, Data analysis, Seasonal variation, Errors.

Nonparametric tests for trends in water quality have been developed because the assumptions of classical parametric methods (i.e., normality, linearity, independence) are usually not met by typical water quality data. Additional idiosyncrasies of the data, such as missing values, censored data, and seaonality, compound the analysis problem. The nonparametric methods are more flexible and can handle these problems more easily. Two classes of procedures, intrablock methods (procedures that compute a statistic, such as Kendall's tau, for each block or season and then sum these to produce a single overall statistic), and aligned rank methods (procedures that remove the block effect from each datum, sum the data over blocks, and then create a statistic from these sums) are examined in detail. Aligned rank methods are asymptotically more powerful than intrablock methods, but intrablock methods are more adaptable. Procedures to analyze more general models, including multistation designs and models, which include a trend-season or trend-site interaction, are developed by using Kendall's tau and intrablock methods. For the analysis of data sets with missing values and multiple values per season values, some possible solutions are adjustment of season length by using a uniform site series consisting of summary statistics, discarding extra observations, filling in missing observations with estimated values, or considering data collected in the same season as tied and using a modified version of tau. The appropriate procedure will depend on the individual data set, but basic statistical concerns include retention of the properties of homoscedasiticy (equal residual errors) and independence. (Moore-IVI)
W84-03419

ENTERIC VIRUSES IN NEW ZEALAND WASTEWATERS,
Otago Univ., Dunedin (New Zealand).
R. S. Simmonds, M. W. Loutit, and F. J. Austin.
New Zealand Journal of Science, Vol. 26, No. 4, p 437-441, 1983. 2 Tab, 19 Ref.

Descriptors: *Viruses, *Wastewater, New Zealand, Pollutant identification, Water treatment, Chlorination, Disinfection, Public health.

The most important disease-causing enteric viruses cannot be readily cultured from environmental samples, but the examination of water and wastewater for the presence of enteroviruses does provide a reliable indication of the presence of infectious virus. Samples from wastewater and treatment plants were tested for human enteroviruses after concentration by adsorption to and elution from bentonite. Nine different viruses were detected in 36 samples at concentrations ranging up to 4000 plaque forming units per liter. Included in the 9 were poliovirus types 1, 2, and 3; coxsackievirus types B2, B4, and B5; and echovirus types 21, 24, and 25. While virus numbers were reduced by chlorine treatment they were still detectable in 11 of the 16 chlorinated samples. Viruses were detected at considerable distances from the point of discharge, and the possibility of sporadic undetected infection exists. (Baker-IVI)
W84-03486

5B. Sources Of Pollution

THE DISTRIBUTION AND ACCUMULATION OF ALUMINUM IN RAINBOW TROUT FOLLOWING A WHOLE-LAKE ALUM TREATMENT,
Eastern Washington Univ., Cheney. Dept. of Biology.
P. M. Buergel, and R. A. Soltero.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 37-44, March, 1983. 3 Tab, 11 Ref.

Descriptors: *Bioaccumulation, *Aluminum, *Rainbow trout, *Whole-lake treatment, *Aluminum sulfate, Ecological effects, Bioindicators, Lake restoration, Chemical analysis, Chemical composition.

Medical Lake, Spokane County, prior to 1977, was subject to high phosphorus concentrations manifested by reduced sediments. Phosphorus inactivation was accomplished by the appliation of 936 metric tons of alum (aluminum sulfate). The immediate and long-term effects of an alum treated environment upon the food chain are generally unknown. Because there has been a deliberate alteration in the natural chemistry of Medical Lake by the alum treatment, there is potential for a bioacumulation of aluminum by organisms inhabiting the lake. Because the fish and their prey are dependent upon a habitat potentially higher in available aluminum than neighboring habitats, trout tissues, plankton and water were analyzed for total aluminum concentrations. Statistical comparisons of experimental and control tissues revealed few overall significant differences ($P = 0.05$) in the level of aluminum between alum-exposed and non-exposed fish, but significant differences existed between tissues within a given treatment and age class. (Murphy-IVI)
W84-02963

LEAD IN DRINKING WATER-INVESTIGATION OF A CORROSIVE WATER SUPPLY,
Morris Township Health Dept., Convent Station, NJ.
For primary bibliographic entry see Field 5F.
W84-02983

RUNOFF FRACTION AND POLLUTION LEVELS IN RUNOFF FROM A WASTE ROCK DUMP UNDERGOING PYRITIC OXIDATION,
Australian Atomic Energy Commission Research Establishment, Sutherland. Environmental Science Div.
J. R. Harries, and A. I. M. Ritchie.
Water, Air and Soil Pollution, Vol. 19, No. 2, p 155-170, 1983. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Rainfall-runoff relationships, *Acid drainage, *Mine wastes, Pyritic oxidation, Oxidation, Water pollution sources, Mine drainage, Dumps, Waste dumps.

A series of measurements was carried out during the 1975-76 and 1976-77 wet seasons, in which the rainfall incident on a waste rock dump, the fraction of rain that appeared as runoff, and the pollution levels in the runoff during runoff events were determined. Rainfall/runoff data was scattered about a curve that could be used to predict the average runoff response of the waste rock dump to rainfall on it. Although a runoff fraction as high as 33% was observed, the runoff fraction was in general quite low, with an average of 15% over the two wet seasons monitored in detail. Although the concentration of pollutants in runoff varied in a characteristic way throughout the discharge events monitored, there were insufficient data of sufficient precision to produce a well defined concentration level/runoff relationship for the dump that could be used in modeling the interaction between runoff water and the dump surface. Present data do show, however, that pollutant levels are largely insensitive to the rainfall pattern during the wet season and to the long rainless period during the dry season. The insensitivity of pollutant levels to the history of rainfall on the dump allows meaningful average pollutant levels to be evaluated and used to predict the annual pollutant load in runoff from the dump. (Baker-FRC)
W84-02987

STUDIES ON BACTERIOLOGICAL QUALITY OF NAINITAL LAKE WATER IN DIFFERENT SEASONS,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
J. Pande, S. M. Das, and D. S. Misra.
Water, Air, and Soil Pollution, Vol. 19, No. 2, p 149-154, 1983. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Water quality, *Coliforms, *Bacteria, *Public health, Recreational water, India, Fecal contamination, Rain, Monsoons.

The density of total coliforms and E. coli in Nainital lake was measured in different seasons during 1978-79. The study was undertaken as a public health investigation as Lake Nainital is visited by more than 100,000 tourists each year and has a local population of 30,000. The raw water of this lake is used for domestic supplies as well as for recreational purposes by tourists and residents. The coliform count of entire lake water showed a distinct seasonal variation. The highest value of coliforms was observed during the rainy season while it was lowest in the winter months. It is believed that during the monsoon months the surface water drained from the surrounding areas of the lake probably added additional waste water from human habitation which could be the main cause for the high coliform count of lake water during the rainy season. This increase was probably due to increased human or animal activity. While there are no Indian Standards for recreational water quality, it is recommended that the total coliform count of 1000 and 5000/100 ml be the limiting values for contact and noncontact recreational waters, respectively, and that the corresponding values of 150 and 750/100 ml for E. coli be established for assessing the probable exposure to pathogenic organisms. The present high values of coliforms and E. coli of Nainital Lake could be considered a direct health menace, particularly in the summer season. (Baker-FRC)
W84-02989

PCB CONTAMINATION IN AND AROUND NEW BEDFORD, MASS,
Norwich Dept. of Public Utilities, CT.
G. Weaver.
Environmental Science and Technology, Vol. 18, No. 1, p 22A-27A, January, 1984. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Polychlorinated biphenyls, *Harbors, New Bedford, Massachusetts, Wastewater treatment facilities, Industrial wastes, Hudson River, Waukegan, Illinois, Bloomington, Indiana, Georges Bank.

New Bedford is the largest revenue-producing fishing port on the United States Atlantic seaboard. This community is bounded by the Acushnet River estuary, New Bedford Harbor, and Buzzards Bay. Past use of polychlorinated biphenyls has left a lasting effect on the vibrant port. Contamination of the Harbor was first noted in 1976. Testing revealed two industrial operations discharging wastewaters containing PCBs. Sediments underlying the entire 440 harbor contain elevated levels of PCBs. Widespread contamination of the Acushnet River estuary and environs resulted in the closing of the area to fishing. Located at the southern terminus of Clark's Point, the New Bedford wastewater treatment plant discharges a daily average of 10 to the 8th power liters of primary treated wastewater to Buzzards Bay. No decrease in PCB content is obvious following treatment. In addition to these sources of PCB contamination, other as yet unidentified dischargers exist. Some abatement procedures have been implemented but the fate of the extensive harbor water quality is still unknown. (Baker-IVI)
W84-03031

NONREVERSIBLE SORPTION OF PHENOLIC COMPOUNDS BY SEDIMENT FRACTIONS: THE ROLE OF SEDIMENT ORGANIC MATTER,
Connecticut Agricultural Experiment Station, New Haven.
P. J. Isaacson, and C. R. Frink.
Environmental Science and Technology, Vol. 18, No. 1, p 43-48, January, 1984. 6 Fig, 2 Tab, 29 Ref.

Descriptors: *Sediments, *Organic matter, *Phenols, Sorption, Hydrogen, Bonding, Chlorophenol, Dichlorophenol, Fate of pollutants.

The environmental fate of many organic chemicals will be determined largely by their sorption interactions with soils or sediments. The organic matter content of natural sorbents is shown to be an important factor in determining their sorption properties. The sorption and desorption of phenol, 2-chlorophenol, and 2,4-dichlorophenol by a fine and coarse sediment fraction were measured in a continuous flow stirred cell. The sorption of up t 0.3 mmol/g of sorbent was not due solely to hy drophobic interactions. Desorption was slowe than sorption, and in some cases up to 90% of th sorbate was irreversibly held. The extensive hys teresis between sorption and desorption shows tha the desorption process is affected by the previou sorption. The penetrability and accessibility of or ganic matter associated with sediment are a majo influence in the sorption of compounds which tak part in extensive hydrogen-bond interactions (Murphy-IVI)
W84-03035

CHEMISTRY AND MICROBIOLOGY OF A SEWAGE SPILL IN SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 5C.
W84-03038

TURBIDITY INTERFERES WITH ACCURACY IN HEAVY METALS CONCENTRATIONS,
S. Stausberg.
Industrial Wastes, Vol. 29, No. 2, p 16-21, March, April, 1983. 2 Fig.

Descriptors: *Industrial wastes, *Heavy metals *Turbidity, Monitoring wells, Wells, Groundwat er, Groundwater pollution, Groundwater manage ment.

Heavy metal concentrations in groundwater at nine-acre non-ferrous metal plant in the northen part of the Atlantic Coastal Plain are largely at tenuated by interstitial claysand silts in the shallov aquifer underlying the plant. Most of the ground water originating from infiltration in the plant' grounds is discharged through the shallow aquife consisting of Pleistocene silty sands and gravel that are interspersed with silty clay lenses. T improve water quality samples taken in the area, a intensive well redevelopment program was under taken in the spring of 1980 to increase well diame ters by removing silt and clay from the aquife outside the gravel pack and stabilize the aquife sand, mainly at the interface. After redevelopment sample analysis indicated that the 1979 water sam ples had turbidity levels more than one order o magnitude higher. (Baker-IVI)
W84-03041

CATTLE GRAZING IMPACT ON SURFACE WATER QUALITY IN A COLORADO FRONT RANGE STREAM,
Rocky Mountain Forest and Range Experimen Station, Fort Collins, CO.
H. L. Gary, S. R. Johnson, and S. L. Ponce.
Journal of Soil and Water Conservation, p 124-128 March-April, 1983. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Surface water, *Water pollutio sources, *Grazing, *Cattle, *Colorado, Suspende solids, Ammonia, Bacteria, Eutrophicatior Manure, Water quality.

Cattle grazing in pastures bisected by a small pe rennial stream in central Colorado had only mino effects on water quality during two years of study Suspended solids and nitrate nitrogen did not in crease significantly. The ammonia nitrogen in creased significantly only once under moderat rates of grazing. Indicator bacteria densities in th stream water were significantly higher when a least 150 cattle were grazing. After removal o cattle or when 40 head of cattle were grazing bacterial counts dropped to levels similar to thos in an adjacent, ungrazed pasture. About 5% of th total manure produced by cattle contributed t pollution and/or enrichment of the stream (Murphy-IVI)
W84-03057

CONTAMINATION ANALYSIS - FLOW NET AND THE MASS TRANSPORT EQUATION,
Florida Atlantic Univ., Boca Raton.
For primary bibliographic entry see Field 2F.
W84-03076

IMPACT OF LAND USE ON GROUND-WATER QUALITY IN SOUTHERN DELAWARE,
Delaware Univ., Newark. Dept. of Agricultural Engineering.
W. F. Ritter, and A. E. M. Chirnside.
Ground Water, Vol. 22, No. 1. p 38-47, January-February, 1984. 1 Fig, 10 Tab, 10 Ref.

Descriptors: *Land use, *Delaware, *Groundwater pollution, *Nitrates, *Water table wells, Poultry, Sussex County, Kent County, Animal wastes, Water pollution sources, Fertilizers, Septic tanks.

In Kent and Sussex counties, ground water is the only source of water. The water-table aquifer contains most of the groundwater reserves. In the coastal areas of Sussex County excessive levels of nitrate were found in the drinking water supplies from 210 wells sampled 12 times each. In noncoastal Sussex and Kent Counties, 272 wells were sampled once each season over a period of one year. Over 99 percent of the wells were in the watertable aquifer. In coastal Sussex County, 32% of the wells had average nitrate concentrations above the EPA drinking water standard of 10 mg/l N. In noncoastal Sussex County and Kent County, 21% and 8% of the wells respectively, had nitrate concentrations above 10 mg/l. The highest nitrate concentrations occurred in areas with intensive broiler production or intensive crop production with excessively-drained soils. Nitrate concentrations in forest areas were <1.5 mg/l. Poultry manure, septic tanks and fertilizers all contributed to the high nitrate concentrations. Poultry manure was one of the major causes of nitrate contamination in four out of the five top prioritized groundwater problem areas. Bacteria contamination was low in all sampling areas. Lead, cadmium and chromium were far below drinking water standards in all but a few wells. (Murphy-IVI)
W84-03077

HYDROLOGIC DELINEATION OF NONPOINT SOURCE CONTRIBUTING AREAS,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
W. J. Gburek.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1035-1048, October, 1983. 7 Fig, 19 Ref.

Descriptors: *Hydrologic delineation, *Nonpoint pollution sources, Land use, Regulations, Rainfall-runoff relationships, Surface flow, Surface runoff, Hydrodynamics, Simulation analysis.

Land-use regulations for reduction of nonpoint source pollution from surface-applied contaminants do not usually consider the differing hydrologic responses of land areas based on soil type, slope, proximity to the stream, and expected rainfall. To help overcome this shortcoming, one can define the area of a watershed contributing surface runoff directly to the stream as the result of any rain. Using design rainfalls and initial watershed soil moisture as input, a map can be drawn showing the return period with which any part of the watershed contributes surface runoff, and thereby potential nonpoint source pollution, to the stream. A small agricultural watershed in east-central Pennsylvania defines the restricted-use areas on a watershed and eliminates the subjective nature of commonly proposed land-use regulations by accounting for both the watershed characteristics and the probabilities controlling the generation of surface runoff and its direct affects on the stream. (Murphy-IVI)
W84-03086

GRAVITY WASTEWATER COLLECTION SYSTEMS OPTIMIZATION,
Indian Inst. of Tech., Bombay.
A. Gupta, S. L. Mehndiratta, and P. Khanna.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1195-1209, October, 1983. 7 Fig, 6 Tab, 22 Ref.

Descriptors: *Gravity flow, *Wastewater collection, *Systems analysis, *Optimum development plans, Algorithms, Computer models, Dynamic programming, Computers, Cost allocation, Cost analysis, Drainage systems, Drainage patterns, Wastewater management, Water quality control.

It is the obligation of wastewater engineers to use optimal design methodology in present times of high cost of wastewater collection system and limited financial resources to meet the commitment of the Government with respect to urban sanitation. A computer algorithm selects the optimal depth-diameter combinations for all links of a complete gravity wastewater collection system using dynamic programming. The algorithm incorporates two subprocesses P1 and P2. The subprocesses P1 generates all feasible designs of inflowing lines at a junction manhole whereas P2 uses these feasible designs to provide the upstream invert level of the outflow line, simultaneously solving the matching problem encountered at each junction manhole. The problem of dimensionality is minimized by exploiting the characteristic features of wastewater collection system. The optimal design for a 10.7 km long collection system at Indian Institute of Technology, Bombay with 52 lines, 245 links, 224 ordinary manholes and 21 junction manholes is compared with conventional design to bring out that the algorithm requires a small computer memory, a small execution time and leads to optimal solution of a complete gravity wastewater collection system. (Murphy-IVI)
W84-03092

CALIBRATION OF NPS MODEL LOADING FACTORS,
Camp, Dresser and McKee, Inc., Annandale, VA.
J. P. Hartigan, T. F. Quasebarth, and E. Southerland.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1259-1272, December, 1983. 8 Fig, 5 Tab, 8 Ref.

Descriptors: *Calibrations, *Nonpoint pollution submodel, *Load distribution, Computer models, Nonpoint pollution sources, Pollution load, Land use, Simulation analysis.

The use of continuous simulation models can facilitate the development of loading factors and loading projections because they deterministically account for the impact of hydrometeorologic and physiographic differences on nonpoint pollution loadings. NPS continuous simulation model calibrated to 11 single-land use watersheds in Chesapeake Bay drainage area derived nonpoint pollution loading factors (total N and total P) for rural, agricultural, and urban land use categories. Flow, rainfall, and nonpoint pollution monitoring records for each test watershed cover approximately 1-1.5 years. Parameter adjustments for calibration of both the hydrologic and nonpoint pollution submodels relied upon NPS model executions with continuous 15-minute rainfall record covering the entire monitoring period. Parametric and nonparametric statistics were used to assess goodness-of-fit for nonpoint pollution loading calibration. In light of the higher power than normal statistics for datasets characterized by small sample sizes and skewed distributions, nonparametric statistics are recommended for goodness-of-fit assessments for nonpoint pollution loading models. Each test watershed site of calibrated NPS loading factors for total N and total P covered forest, pasture, high tillage cropland, low tillage cropland and urban residential land use categories. Simulated annual unit area loads for each land use are compared for years of normal and above-average rainfall. (Murphy-IVI)
W84-03093

RESERVOIR CIRCULATION PATTERNS AND WATER QUALITY,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 2H.
W84-03094

DIFFUSIVITY-BASED FLUX OF PHOSPHORUS IN ONONDAGA LAKE,
Upstate Freshwater Inst., Syracuse, NY.
M. C. Wodka, S. W. Effler, C. T. Driscoll, S. D. Field, and S. P. Devan.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1403-1415, December, 1983. 5 Fig, 1 Tab, 28 Ref.

Descriptors: *Diffusion coefficient, *Fluctuations, *Phosphorus, *Onondaga Lake, Thermal stratification, Organic matter, Organic load, Isotherms, Water pollution effects.

High concentrations of critical phytoplankton nutrients commonly develop in the hypolimnia of productive lakes as a result of mineralization processes on organic matter depositing from the upper productive waters. The upward transport of phosphorus through the lower portion of the metalimnion of hypereutrophic Onondaga Lake, is mediated by vertical diffusivity. This upward flux is simulated by Fickian diffusion, which incorporates estimates of the vertical diffusivity coefficient for heat and measurements of the vertical phosphorus gradient. The turbulent component of vertical diffusivity demonstrated a strong seasonality during the stratification period, varying from 0.060 sq cm/sec in early summer to 0.002 sq cm/sec during the maximum stability period of late summer. The total dissolved phosphorus gradient increased during stratification to a maximum of 0.14 mg/L/m in late August and early September. The internal loading of phosphorus to the epilimnion from diffusivity-based transport during the study is approximately 21% and 18%, respectively, of the external loading of dissolved and total phosphorus. The elimination of the present industrial ionic loading to the lake could result in increased internal loading of phosphorus through vertical transport by as much as a factor of 7. (Murphy-IVI)
W84-03097

ACCUMULATION OF PCBS, MERCURY AND CADMIUM BY NEREIS VIRENS, MERCENARIA MERCENARIA AND PALAEMONETES PUGIO FROM CONTAMINATED HARBOR SEDIMENTS,
Environmental Research Lab., Gulf Breeze, FL.
N. I. Rubinstein, E. Lores, and N. R. Gregory.
Aquatic Toxicology, Vol. 3, No. 3, p 249-260, April, 1983. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Bioaccumulation, *Polychlorinated biphenyls, *Mercury, *Cadmium, *Sandworms, *Clams, *Shrimp, *Contamination, *Sediments, Dredging, Ocean dumping, Fate of pollutants, Bioindicators, Coastal zone management, Water quality management, Water pollution control.

To ensure that disposal operations are conducted with a minimal degree of risk, dredged material destined for ocean disposal must be evaluated on the basis of criteria established by the Environmental Protection Agency. Disposal evaluations currently utilize bioassays to detemine the biological availability of contaminants associated with dredged sediments. In a 100-day period in New York Harbor sandworms (Nereis virens), hard clams (Mercenaria mercenaria) and grass shrimp (Palaemonetes pugio) had an accumulation of polychlorinated biphenyls (PCBs), mercury, and cadmium. Of the three contaminants monitored, only PCBs were found to bioaccumulate above background (control) concentrations. Small increases in PCB body burden were in M. mercenaria and P. pugio, whereas higher concentrations were in N. virens. Uptake was affected by the organic content of the sediment. Bioaccumulation factors (concentration in tissue/concentration in sediment) for N. virens ranged from 1.59 in a low organic sediment to 0.15 in a high organic sediment. Sediment concentration alone does not reflect bioavailability and toxicity tests (bioassays) and field monitoring remain the most direct method for estimating bioaccumulation potential of sediment-bound contaminants. (Murphy-IVI)
W84-03112

PCB DYNAMICS IN HUDSON RIVER STRIPED BASS, II. ACCUMULATION FROM DIETARY SOURCES,
New York Univ. Medical Center, NY. Inst. of Environmental Medicine.
J. C. Pizza, and J. M. O'Connor.
Aquatic Toxicology, Vol. 3, No. 4, p 313-327, May, 1983. 5 Fig, 3 Tab, 32 Ref. NIEHS grant ES 00260.

Descriptors: *Polychlorinated biphenyls, *Fish, *Fate of pollutants, Hudson River, Bass, Pharmacokinetics, Organic compounds, Industrial wastes, Water pollution effects, Bioaccumulation.

The entire food web of the Hudson esturary is contaminated with PCB. It may be assumed, therefore that PCB accumulation by fish is due partly to direct uptake from water and partly due to accumulation from the diet. Young-of-year striped bass given known doses of (14)C-labeled Aroclor 1254 in natural food by gavage had polychlorinated biphenyl accumulation from the gut. Elimination from the whole body were determined empirically for single-dose and multiple-dose studies. The data have been applied to models describing adsorption site kinetics and fluctuations in whole body burden at steady state. Those variables critical to the calculation and understanding of bioaccumulation factors, namely growth, metabolic rate, and dose, are discussed in the context of the kinetic model results. (Baker-IVI)
W84-03113

COPROSTANOL DISTRIBUTION FROM SEWAGE DISCHARGE INTO SARASOTA BAY, FLORIDA,
Mote Marine Lab., Sarasota, FL.
R. H. Pierce, and R. C. Brown.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 1, p 75-79, January, 1984. 1 Fig, 15 Ref.

Descriptors: *Pollutant identification, *Wastewater treatment, Coprostanol, Feces, Sarasota Bay, Florida, Wastewater, Sewage bacteria, Fate of pollutants.

Distribution of the fecal sterol, coprostanol, in sediment from 41 sites throughout Sarasota Bay, Florida, determined the impact of sewage effluent discharged from the City of Sarasota's wastewater treatment plant. Coprostanol was used as the indicator to estimate the extent to which sewage-derived particulate matter has been distributed within Sarasota Bay sediment. To estimate the area of the bay impacted by the sewage effluent, it is assumed that a coprostanol concentration of more than 10 ng/g dry-weight sediment indicates the presence of sewage derived material. The area affected by corprostanol was about 36 sq km. To observe corprostanol input from non-sewage effluent sources, sediment was taken from the mouth of two tributary draining areas of land-use similar to Whitaker Bayou. These sites were Bowless Creek and Hudson Bayou. The relatively high coprostanol concentration found in Hudson Bayou may be related to sewage due to periodic overflow that has been documented from sewer lines in that area. (Baker-IVI)
W84-03130

THE GEOCHEMISTRY OF IRON AND MANGANESE IN THE WATERS AND SEDIMENTS OF BOLSTADFJORD, S. W. NORWAY,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W84-03135

CARBON DIOXIDE EMISSION AND CARBON ACCUMULATION IN COASTAL WETLANDS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, R. D. DeLaune, and W. H. Patrick, Jr.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 1, p 21-29, July, 1983. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Carbon dioxide, *Emission, *Accumulation, *Coastal marshes, Fluctuations, Carbon cycle, Marshes, Detritus, Accretion, Organic carbon, Chemical properties, Barataria basin, Louisiana.

Carbon dioxide production and subsequent release to the atmosphere are important processes in the overall carbon budget in coastal wetlands. Direct measurements of CO2 fluxes from salt, brackish and freshwater marshes in Barataria Basin, Louisiana, had accumulations of 418, 180 and 618 g C/sq m respectively. Water bodies adjacent to the marsh evolved 103, 54 and 242 g CO2-C/sq m/yr to the atmosphere from saline, brackish and freshwater lakes, respectively. The marshes are a major carbon sink because of the carbon content of the sediment, vertical accretion rates and the bulk density of the sediment. Net carbon accumulation was essentially the same in all three marshes; 183, 296 and 224 g C/sq m/yr from the salt, brackish and fresh marsh, respectively. there is a limited net export of carbon from these coastal marshes. A large percentage of fixed carbon remained on the marsh, being immobolized in accretionary processes or lost to the atmosphere as CO2. (Murphy-IVI)
W84-03136

TRACE METALS IN THE GOTA RIVER ESTUARY,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
L. G. Danielsson, B. Magnusson, S. Westerlund, and K. Zhang.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 1, p 73-85, July, 1983. 9 Fig, 1 Tab, 17 Ref.

Descriptors: *Trace metals, *Gota River, *Estuaries, Sediment transport, Sediment distribution, Particulate matter, Path of pollutants, Mixing, Cadmium, Copper, Iron, Nickel, Lead, Zinc, Sweden.

The Gota River and its estuary are relatively unpolluted compared to other similar areas. The estuary represents a salt wedge type estuary and is situated in a densely populated region of Sweden. The concentrations of trace metals Cd, Cu, Fe, Ni, Pb and Zn are in the range regarded as background levels for freshwater. Metal fractions include acid-leachable, dissolved, labile and particulate. When water with low suspended matter concentration reaches the estuary conservative behavior of the trace metals generally occurs, the main exceptions being dissolved iron and lead. These are the only elements that partly exist in colloidal form in the Gota River estuary. The processes of removal of dissolved trace metals is not very effective. The conservative behavior of several trace metals may be due to the low dissolved iron concentration. Although iron is partly removed the amount of new iron-rich particles formed in the estuary is too small to influence the dissolved concentration of the other trace metals, save lead. (Murphy-IVI)
W84-03137

QUALITY CHANGES IN BAGHDAD CANALS AND IRRIGATION,
Biological Research Center, Baghdad (Iraq). Dept. of Pollution Research.
M. F. Al-Shahwani, M. W. Ishaq, A. K. Al-Hindawi, S. A. Ali, and N. Muthafar.
Journal of Environmental Sciences and Health, Vol. A18, No. 6, p 773-785, 1983. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Baghdad, *Iraq, *Canals, *Water quality, Irrigation canals, Domestic wastes, Coliforms, Diatoms, Water pollution sources, Heavy metals, Saline water.

The change of physical, chemical and biological characteristics of Al-Jaysh and Al-Khair canals are due to continuous untreated discharge of domestic waste. Al-Jaysh contained higher turbidity and electrical conductivity than Al-Khair. Both parameters decreased from up to down stream. Fecal coliform and diatom amounts in both canals were about the same. Diatoms decreased from up to down stream and had a higher resistance than fecal coliform at Al-Khair. Al-Khair contained higher biological oxygen demand than Al-Jaysh. There was no sign of self purification for both canals. In general, heavy metals decreased from up to down stream. Sedimentation of these metals, rather than precipitation, was more important. In most of the agriculture area in Baghdad, a build up of salt due to excessive irrigation and the absence of drainage can amount to 12.7 t/ha/year from Al-Jaysh, and 11.5 t/ha/year from Al-Khair. (Murphy-IVI)
W84-03148

PCB AND DDT CONCENTRATIONS OF SEDIMENTS FROM SWISS SHORELINE OF LAKE GENEVA, SWITZERLAND, (CONCENTRATIONS EN PCB ET DDT DES SEDIMENTS SUPERFICIELS DE LA RIVE SUISSEC DU LAC LEMAN),
Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. du Genie de l'Environnement.
P. G. Burgermeister, K. Aswald, L. Machado, J. Mowrer, and J. Tarradellas.
Schweizerische Zeitschrift fur Hydrologie, Vol 45, No. 1, p 233-245, October, 1983. 4 Fig, 4 Tab 27 Ref.

Descriptors: *Polychlorinated biphenyls, *DDT, *Sediments, *Lake Geneva, *Switzerland, Pesticides, Lake shores, Graphical analysis, Pollutant identification, Water pollution.

The concentrations of PCB, p,p'-DDT, p,p'DDD and p,p'-DDE from sediment samples from the shoreline of Lake Geneva were taken at 15 places at depths varying between 10 and 25 m. The PCB concentrations, expressed in dry weight of sediment, varied from 20 micrograms/kg in the region of Les Grangettes to 420-430 micrograms/kg in the Lausanne area. These concentrations are high and could produce a long-term contamination of the Lake Geneva ecosystem. The PCB identified consisted mainly of moderately and highly chlorinated biphenyls. The concentration of p,p'-DDT, p,p'-DDD and p,p'-DDE, expressed in dry weight of sediment, varied from 0.5 micrograms/kg in the region of Les Grangettes to 49 micrograms/kg in the Cully area. These types of pollution (especially DDT) are decreasing in the lake ecosystem. (Murphy-IVI)
W84-03173

EFFECT OF SOLUBLE SPECIES RELEASED FROM SOIL SOURCES ON THE COMPOSITION OF SOIL AND DRAINAGE SOLUTIONS,
Agricultural Research Organization, Bet-Dagan (Israel).
R. Levy, I. Shainberg, R. Mazouz, and H. Eisenberg.
Soil Science Society of America Journal, Vol. 47, No. 6, p 1092-1096, November/December, 1983. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Irrigation water, *Minerals, *Leachates, *Soil chemistry, Chlorides, Bicarbonates, Sodium, Soil solution, Calcium, Magnesium, Water pollution sources, Dissolution.

Two soils differing in the amounts of calcium and magnesium released during dissolution of soil minerals, cation exchange capacity (CEC), lime content, and water-holding capacity were irrigated under the same conditions with four synthetic waters. Two of the waters contained only chloride and the other two contained both chloride and bicarbonate anions. Sodium adsorption ratios of the two chloride and two bicarbonate waters were either 10 or 20. Following every 10 wetting and drying cycles the two soils were leached with about 10% excess water. Five such leachates were collected and analyzed. Soil analysis was performed after 20 and 40 irrigation cycles. A significant difference was found between the chemical composition of the drainage and soil solutions of the two soils. To evaluate this diversity, the law of mass conservation was used to calculate the amounts of calcium and magnesium released by dissolution in the absence and presence of carbonate precipitation. Two assumptions were used in these calculations: (i) during irrigation with the chloride waters no precipitation of carbonates occurred, and (ii) during irrigation with the bicarbonate waters no dissolution took place. These assumptions proved valid only for the soil that released small amounts of salt by dissolution. The two soils released almost equal amounts of calcium and magnesium from exchange sites, although there was a significant difference in CEC. It was concluded that the primary source that induced the differences in chemical composition of the drainage and soil solutions was the amount of calcium and magnesium released by mineral dissolution. (Author's abstract)
W84-03180

INVESTIGATIONS ON HEAVY METAL SPECIATION IN NATURAL WATERS BY VOLTAMMETRIC PROCEDURES,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
H. W. Nurnberg.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 316, No. 6, p 557-565, November, 1983. 6 Fig, 1 Tab, 56 Ref.

Descriptors: *Heavy metals, *Chemical speciation, *Voltammetry, Natural waters, Water pollution, Complexation, Metalloids.

The speciation of dissolved heavy metals is of great significance for their interactions with suspended matter and sediments and their uptake by aquatic organisms. Substance-specificity combined with extraordinary detection sensitivity and inherently high accuracy make suitable advanced modes of polarography and voltammetry one of the most powerful and convenient methodological approaches for speciation studies of heavy metals of ecotoxic significance in all types of natural water. Not all heavy metals are accessible to voltammetry, but voltammetry is one of the most powerful methods for studies of heavy metals and metalloids of predominant ecotoxic significance and impact. Diagnostic information on the speciation and distribution emerge in the course of the analytical procedure for the determination of the overall heavy metal concentrations in the dissolved state and the suspended matter phase of natural waters. The complexation capacity is conveniently determined by a voltammetric titration. A very important and successful application area of voltammetry in heavy metal speciation research is specific studies with defined heavy metal complex species on the general physiochemical parameters governing the speciation of the heavy metal in various natural water types. Dissolved heavy metals exist in natural waters in three categories of species: labile complexes, predominantly formed with inorganic ligands; free hydrated cations; and stable non-labile complexes, predominantly of natural origin but in certain pollution situations also from anthropogenic sources. (Moore-IVI)
W84-03185

ON THE COORDINATION BETWEEN METALS AND AQUATIC HUMIC MATERIAL (ZUR KOORDINATIVEN BINDUNG VON METALLIONEN AN GEWASSERHUMINSTOFFE),
Technische Univ., Munich (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
F. H. Frimmel, and J. Geywitz.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 316, No. 6, p 582-588, November, 1983. 3 Fig, 9 Tab, 31 Ref.

Descriptors: *Humic substances, *Metals, *Chemical binding, Copper, Dissolved organic carbon, Complexation, Heavy metals, Iron, Hydroxamic acid, Photochemical decomposition, Ligands.

Humic substances (HUS) are present in all aquatic systems. Their analytical identification and quantification suffers from a lack of knowledge of the general structure. Therefore sum- and group-parameters, such as dissolved organic carbon (DOC) or carboxylic groups, are of great importance for the characterization of humic substances and their reactivity. Humic/metal interactions can be determined under defined reaction conditions. Model experiments are helpful to confirm these results. Complexation capacities (CC) reflect the maximum of metal binding ability for the unit of HUS. The CC in respect to Cu(II) was determined by the titration of the initial amount of Cu(II) (10 micro mol/l) with a HUS-solution of known DOC at a pH-value of 6.8. Differential pulse polarography with a dropping mercury electrode was used for detection. The results (2 to 7 micro mol per mg DOC) suggest complex formation by oxygen containing functional groups in addition to nitrogen containing ones. Iron, strongly bound to HUS even at pH 2.2, shows some similarities to Fe(III) in hydroxamic acid compounds. Coordination of Hg(II) onto thio-groups of the humics can be confirmed by means of photochemical decomposition reactions using model ligands and natural samples. CCs for isolated humics suggest that in most natural aquatic systems there is an excess of organic ligand functions compared with the dissolved heavy metals. CCs, however, should only be discussed in close connection with the determination method applied and the reference metal concerned. (Author's abstract)
W84-03187

BONDING FORMS OF HEAVY METALS IN SEDIMENTS AND SLUDGES: SORPTION/MOBILIZATION, CHEMICAL EXTRACTION AND BIOAVAILABILITY (BINDUNGSFORMEN VON SCHWERMETALLEN IN SEDIMENTEN UND SCHLAMMEN: SORPTION/MOBILISIERUNG, CHEMISCHE EXTRAKTION UND BIOVERFUGBARKEIT),
Technische Univ., Hamburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
U. Forstner.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 316, No. 6, p 604-611, November, 1983. 7 Fig, 5 Tab, 70 Ref.

Descriptors: *Heavy metals, *Chemical binding, *Sediments, *Sludge, *Bioavailability, Extraction, Sorption, Mobilization, Iron, Manganese, Organic matter, Chemical speciation, Aquatic environment.

Only part of the metals present in sediments or sludges are involved in short-term geochemical processes and/or are bioavailable. Hydrous Fe- and Mn-oxides as well as organic matter, partly as coatings or films on detrital grains, are important substrates for the interactions with dissolved metal species in aquatic systems. For the differentiation of the relative bonding strength of metals on various solid phases and for the estimation of their potential reactivity under variable environmental conditions sequential extraction procedures were used. While these determinations seem to pose basically operational problems, the correlation of the data from solid speciation with the processors and extent of the biological uptake is still unsatisfactory. This is mainly due to the competition between sorption sites on solid matter and biological processes for dissolved metals. Investigations on pore waters could give useful indications on the availability of metals for organisms. (Author's abstract)
W84-03188

EFFECTS OF SURFACE MINING ON AQUATIC RESOURCES IN NORTH AMERICA,
L. B. Starnes.
Fisheries, Vol. 8, No. 6, p 2-4, November-December, 1983. 5 Ref.

Descriptors: *Surface mining, *Environmental effects, *Hydrologic systems, Aquatic habitats, Land reclamation, Planning, Resources management, Wetlands.

Mining may result in long-term disruption of terrestrial and aquatic habitats, and hydrologic systems. The magnitude of surface mining impacts on aquatic life depends on the mining technology employed, extent of the disturbance, chemical and physical composition of the mineral, surface and subsurface hydrologic patterns, and methods of reclamation. Research and monitoring needs associated with specific minerals or mining technologies include methodology, development, wetland reclamation strategies, stream strategies and methods of predicting eventual toxicity. This encompasses a need for collaborative data bases and regionalized computer models to provide alternative strategies and a priori answers concerning when multiple mines will create unacceptable impacts. (Murphy-IVI)
W84-03197

FLUORIDE POLLUTION IN FRENCH RIVERS AND ESTUARIES,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 2L.
W84-03202

LAGRANGIAN METEOROLOGY AND MEASUREMENTS OF ACIDIC PRECIPITATION AT WASHINGTON, D.C.,
National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Labs.
R. R. Draxler.
Atmospheric Environment, Vol. 17 No. 12, p 2525-2531, 1983. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Lagrangian meteorology, *Acid rain, *Washington, *District of Columbia, Hydrogen ion concentration, Temperature, Rainfall, Humidity, Model studies, Air pollution, Fate of pollution, Sulfur compounds, Nitrogen compounds, Chemistry of precipitation.

Various studies have attempted to link episodes of acidic rainfall with particular source regions without considering the intervening chemical and physical processes of Eulerian and Lagrangian models using an emmission inventory coupled with rainfall chemistry-modules to account for sulfate deposition over the region of interest. In the latter, more complex models, it is presumed that the rainwater pH is related to the SO4/NO3 deposition. Lagrangian averages of temperature, rainfall, relative humidity and normalized concentration from a multiple source trajectory model compares with measurements of pH from daily rainwater samples collected around the Washington, DC area during 1975. A linear regression procedure in which pH depends upon the previous four parameters determines the likely source regions during the year. The most consistent acidic rainfall occurred during an extended period from May to June when the flow was from the north. Some investigators have suggested that the rainfall at the receptor is a better predictor of pH than the Lagrangian precipitation. Tests of the four independent variables indicated that the most important predictor of pH during the summer was average rainfall along the trajectory (slope > 0). The variability of the meteorological conditions along the pollutant trajectories was able to explain half of the variance of pH, suggesting that at least during summer complex chemical models may not be necessary to simulate acidic precipitation. During the winter, the results were more ambiguous, with the normalized concentration appearing to be the best predictor of pH. (Murphy-IVI)
W84-03286

CHEMICAL COMPOSITION OF WATERBODIES IN THE ENGLISH LAKE DISTRICT: RELATIONSHIPS BETWEEN CHLORIDE AND OTHER MAJOR IONS RELATED TO SOLID GEOLOGY, AND A TENTATIVE BUDGET FOR WINDERMERE,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 2K.
W84-03293

MICROBIAL HETEROTROPHIC UTILIZATION OF DISSOLVED ORGANIC MATTER IN A PIEDMONT STREAM,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
L. A. Kaplan, and T. L. Blott.
Freshwater Biology, Vol. 13, No. 4, p 363-377, August, 1983. 6 Fig, 8 Tab, 35 Ref. NSF grant DES 77-12902.

Descriptors: *Microbial utilization, *Dissolved organic matter, *Piedmont, *Streams, Streambeds, Sediments, Bacteria, Dissolved organic carbon, Biosynthesis, Stormflow, White Clay Creek, Pennsylvania, Leachate.

Dissolved organic matter (DOM) contributes significantly to the total organic matter budgets of streams and rivers, often dominating the pool of organic matter in transport. The microbial heterotrophic utilization of (DOM) was determined experimentally in microcosms using stream water and stream-bed sediments from a third order reach of White Clay Creek (Pennsylvania, U.S.A.). Sources of DOM for the experiments included White Clay Creek water at baseflow and stormflow and cold water extracts of jewel weed (Impa-

tiens capensis L.) and spicebush (Lindea benzoin (L.) Blume). The heterotrophic activity of the sediments was measured as uptake of the following: dissolved organic carbon (DOC), molecular weight fractions within the DOC pool, carbohydrates, amino acids and peptides, phenolics, and dissolved oxygen (DO), all in the overlying water. Concentrations of adenosine triphosphate (ATP), and direct microscopic counts of bacteria were used to estimate bacterial biomass in the surface sediments. The microcosm experiments showed that specific DOC molecular size classes and DOM functional groups were selectively removed from solution, exposure to one DOM source affected responses to a different DOM source and certain DOM sources were more readily utilized than others. Continued exposure to a DOM source increased microbial heterotrophic activity (a condition which persisted even after removal of the DOM source for several days). Rates of biotic DOC uptake ranged from 3.6 to 242.8 mg C/sq m/h. 8. Indirect estimates of biosynthesis calculated from DOC and DO data ranged from 1.6 at baseflow and 2.6-61.2 at stormflow to as high as 192.6 mg C/sq m/h when the community was repeatedly exposed to enriched DOM sources. The mean generation tin.es of bacteria in sediments, determined from direct microscopy data, ranged from 12.5 to 46.2 h at 15 degrees C. (Murphy-IVI)
W84-03295

RELATIONSHIPS BETWEEN CHLORIDE AND MAJOR CATIONS IN PRECIPITATION AND STREAMWATERS IN THE WINDERMERE CATCHMENT (ENGLISH LAKE DISTRICT),
Freshwater Biological Association, Windermere (England).
D. W. Sutcliffe, and T. R. Carrick.
Freshwater Biology, Vol. 13, No. 5, p 415-441, October, 1983. 16 Fig, 11 Tab, 79 Ref.

Descriptors: *Chloride, *Cations, *Precipitation, *Windermere catchment, *Streams, Hydrogen ion concentration, Sodium, Potasium, Calcium, Magnesium, Water pollution sources, Fate of pollutants, Pollution load, Ions, Chemistry of precipitation, England.

Before starting to manipulate the concentrations of solutes we need to know their natural range and identify major sources of variation in local streams. Variation in stream water concentrations can be directly related to input by precipitation on the Windermere catchment. The distribution of invertebrates in hill-streams is related to the chemical composition of streamwater, especially with regard to the concentrations of H(+). Low concentrations of other major ions, Na(+), K(+), Cl(-), might also be important limiting elements for some taxa. Relative contributions of inputs were from precipitation, rocks (Borrowdale Volcanics) and soils, sewage, and deicing salt used on highways. In bulk precipitation, ratios of Na(+)/Cl(-) (as microequiv/l) ranged from 0.41 to 1.83 over a 2-year period. The overall volume-weighted mean ratio was 0.86, as in seawater, but 2.4% (1975) and 5.7% (1976) of Cl(-) was non-marine in origin, being balanced by H(+) (in winter), K(+) and Ca(2+) (in summer). In moorland headwater streams, Cl(-) is largely derived from precipitation; there is a pronounced annual cycle of midwinter high and midsummer low concentrations unrelated to stream discharge. Na(+) and K(+) display similar cycles but Na(+), Ca(2+) and Mg(2+) (and pH) are discharge-related due to leaching from rocks and soils: 10-20% Na(+), 15-17% Mg(2+) and 65-75% Ca(2+) are so-derived whereas K(+) comes from precipitation. Na(+)/Cl(-) ratios in streams on Borrowdale Volcanics alter seasonally, with midsummer values > 1.0. Lower values occur in streams on Silurian Slates where some Cl(-) is apparently derived from rocks. Seasonal changes in streamwater concentrations of Cl(-), Na(+) and K(+) are exponentially related to time. Instantaneous rates of change (%/day) are compared in relation to position in the catchment and inputs from anthropogenic sources. Deicing salt has raised (10-100-fold) the concentrations of Na(+) and Cl(-) in streams on mountain passes; the effects persist throughout the year. (Murphy-IVI)
W84-03297

MODEL OF PCB IN THE LAKE MICHIGAN LAKE TROUT FOOD CHAIN,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
R. V. Thomann, and J. P. Connolly.
Environmental Science and Technology, Vol. 18, No. 2, p 65-71, February, 1984. 7 Fig, 1 Tab, 35 Ref. CR 805916010.

Descriptors: *Fish, *Water pollution effects, Polychlorinated biphenyls, Organic compounds, Food chains, Model studies.

The significance of the food chain route, i.e., the degree to which a chemical such as PCBs may be accumulated in an organism by predation, needs to be placed in a mechanistic predictive framework to be able to calculate expected levels under field conditions. An age-dependent food chain model that considers species bioenergetics and toxicant exposure through water and food is developed. The model is successfully calibrated to 1971 PCB concentrations of Lake Michigan alewife and lake trout by using a dissolved PCB concentration in the water of 5-10 nanograms/liter. The model indicates that for the top predator lake trout, PCB exposure through the food chain can account for greater than 99% of the observed concentration. An octanol-water partitioning calculation and lake trout lipid concentrations failed to reproduce the observed data by a factor of about It is estimated that a criterion specifying that PCB concentrations of all ages of lake trout be at or below 5 micrograms/g in the edible portion would requrie that dissolved PCB concentrations be reduced to somewhere between 0.5 and 2.5 ng/liter. The projections of the behavior of the lake trout food chain to reduced water concentrations indicate that following reduction in water column PCB concentrations, a period of about 5 years is needed to reduce whole body PCB concentration in upper age class lake trout. Younger age classes can generally be exposed to higher water PCB concentrations than older age classes without exceeding the objective of 5 micrograms/g. If water quality projections indicate a lower bound in the achievable PCB water concentrations, a size-dependent fish consumption guideline can be developed. (Baker-IVI)
W84-03326

SOURCES AND TRANSPORT OF HYDROCARBONS IN THE GREEN-DUWAMISH RIVER, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
S. E. Hamilton, T. S. Bates, and J. D. Cline.
Environmental Science and Technology, Vol. 18, No. 2, p 72-79, February, 1984. 3 Fig, 2 Tab, 33 Ref.

Descriptors: *Hydrocarbons, *Water pollution sources, *Rivers, Green-Duwamish River, Washington, Estuarine environments, Sewage discharge, Wastewater treatment facilities, Wastewater.

Hydrocarbon compounds are introduced into nearshore waters by wastewater discharge, surface runoff, casual spillage, and atmospheric deposition. Since petroleum hydrocarbons are largely hydrophobic and lipid soluble, a major transport mechanism of these compounds in riverine and estuarine systems is via their association with suspended particulates. Five major sources of hydrocarbons have been defined along the Green-Duwamish River. The plant wax hydrocarbons are the predominant compounds in the upper river. Pentadecane, heptadecane, and several C-17 monoenes are produced by algae in the river. Highway runoff along the river contributes the suite of C14-C20 alkanes. The terpenoids and high concentrations of pristane appear to be erosional in origin and are periodically transported down the river under high flow conditions. A secondary waste treatment plant is a major point source of hydrocarbons to the river. The differences in hydrocarbon concentrations between test stations can be largely attributed to simple dilution. A disparity was noted when attempts were made to quantitatively account for the input from the Renton Sewage Treatment Plant. This disparity may be due to the flocculation and sedimentation of organic matter during mixing of the effluent and river water with subsequent near-bottom transport of this material during periods of high river flow. (Baker-IVI)
W84-03327

SEWAGE SLUDGE COAGULATION AND SETTLING IN SEAWATER,
California Univ., Berkeley. Div. of Sanitary, Environmental, Coastal, and Hydraulic Engineering.
J. R. Hunt, and J. D. Pandya.
Environmental Science and Technology, Vol. 18, No. 2, p 119-121, February, 1984. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Sludge coagulation, *Settling, *Seawater, *Particulates, Model studies, Coagulation, Mathematical models, Sludge disposal, Fate of pollutants.

The removal of sewage sludge particles from seawater is controlled by particle coagulation and the settling of aggregates as they are formed. Anaerobically digested sewage sludge coagulation in artificial seawater at fluid shear rates of 0, 0.25, 0.5, 1, 2, 4, and 8/s with a rotating cylinder apparatus had a sludge removal rate with a second order in sludge concentration and was dependent on the fluid shear rate. The settling velocity of aggregates produced at a given shear rate was constant. Limited experience to date suggests that particle coagulation rate and aggregate settling velocity are very dependent on fluid and particle properties. For this reason, specific data must be obtained for each waste under consideration. (Murphy-IVI)
W84-03328

AFFINITY OF HYDROPHOBIC POLLUTANTS FOR NATURAL ESTUARINE COLLOIDS IN AQUATIC ENVIRONMENTS,
Maryland Univ., Solomons. Chesapeake Biological Lab.
R. D. Wijayaratne, and J. C. Means.
Environmental Science and Technology, Vol. 18, No. 2, p 121-123, February, 1984. 1 Fig, 12 Ref.

Descriptors: *Herbicides, *Estuarine environment, Aquatic habitats, Water pollution effects, Chemical reactions, Colloids, Chromatography, Oxidation.

Gel chromatographic techniques were used to study the interaction of natural estuarine colloids with a model herbicide, (14)C labeled atrazine. Dissolved organic carbon binds atrazine and holds the resulting aggregate of molecules in stable colloidal suspension. Hydrophobic compounds held in such a manner show behavior characteristic of the natural organic matter rather than the behavior they would normally exhibit in solution. Oxidation of the compound-colloid complex by hydrogen peroxide or hypochlorite resulted in the partial destruction of the complex and release of bound herbicide. The average molecular weight of the estuarine polymer was estimated to be 10,000. The molecular weight is decreased with oxidation. Recoveries of radiolabeled atrazine from the gel chromatograpy studies in distilled water, estuarine colloids, and colloids treated with NaOCl and H2O were 80%, 90%, 84%, and 82%, respectively. Depending on their stability in the colloidal state hydrophobic contaminants can accumulate in concentrations far in excess of that expected for pure water. As surface-active organic matter is ubiquitous in natural waters, it seems reasonable to conclude that colloids may play a significant role in the distribution and concentration of trace quantities of hydrophobic contaminants in aquatic systems, which might otherwise be sequestered in sediments. (Baker-IVI)
W84-03329

PROCESSES CONTROLLING METAL ION ATTENUATION IN ACID MINE DRAINAGE STREAMS,
Commonwealth Scientific and Industrial Research Organization, Ryde (Australia). Physical Technology Unit.
B. M. Chapman, D. R. Jones, and R. F. Jung.

Geochimica et Cosmochimica Acta, Vol. 47, No. 11, p 1957-1973, November, 1983. 10 Fig, 5 Tab, 51 Ref.

Descriptors: *Acid mine drainage, *Metals, Heavy metals, Iron, Potassium, Lead, Copper, Zinc, Cadmiun, Sediments, Water analysis, Streams, Mine drainage, Water pollution source.

The study of the distribution of heavy metals at trace levels in uncontaminated natural streams provides information about the mechanisms which control the mobility of these elements at low concentrations. Detailed analyses were made of the sediments and waters in two acid mine drainage streams to understand the dominant processes controlling the transport and attenuation of heavy metals under conditions of chronic high-level pollutant input. One of the water courses has a thick hydrous iron oxide crust on its bed, where bioticaly mediated oxidation of ferrous iron resulted in precipitation of amorphous ferric hydroxide, along with substantial quantities of adsorbed silica, sulfate and Al and lesser quantities of As. Small amounts of K and Pb jarosites were also present in the sediments. Changes in pH and in the concentrations of Cu, Zn, and Cd appear to be mainly the result of dilution by seeps and tributaries. Although no sediment was recovered during collection of water samples from the second stream, saturation index calculations imply that precipitation was occurring. The basis for a potentially useful new tecnique, congruent element analysis, which enables the identification of conservative components in streams is presented. Comparison of logarithmic concentration versus distance plots delineates the point where chemical removal mechanisms become important for each element. (Baker-IVI)
W84-03331

TRANSFORMATIONS OF TETRACHLOROETHENE AND TRICHLOROETHENE IN MICROCOSMS AND GROUNDWATER,
Florida International Univ., Miami. Drinking Water Quality Research Center.
F. Parsons, P. R. Wood, and J. DeMarco.
Journal of the American Water Works Association, p 56-59, February, 1984. 3 Tab, 20 Ref.

Descriptors: *Transformation, *Tetrachloroethene, *Trichloroethene, *Microcosms, *Groundwater, Chemical reduction, Cis-1,2-dichloroethene, Trans-1,2-dichloroethene, Muck soils, Metal-finishing wastes, Incubation.

Cis- and trans-1,2-dichloroethene are found in well water at a site contaminated with trichloroethene from a leaking storage tank, although neither compound was used in the vicinity nor was present as an impurity in the trichloroethene in the storage tank. The use of tetrachloroethene and trichloroethene in dry cleaning and metal refinishing plants is widespread. Several chloroethene compounds that are found in southern Florida groundwater may have been formed from these solvents via microbial metabolism in the groundwater environment. Depletion of tetrachloroethene and appearance of cis- and trans-1,2-dichloroethene and chloroethene are present following incubation of tetrachloroethene in microcosms containing muck from the aquifer recharge basin. (Murphy-IVI)
W84-03367

RADIOCHEMICAL TECHNIQUES APPLIED TO LABORATORY STUDIES OF WATER LEACHING OF HEAVY METALS FROM COAL FLY ASH,
Commission of the European Communities, Ispra (Italy). Radiochemistry and Nuclear Chemistry Div.
L. Goetz.
Water Science and Technology, Vol. 15, No. 11, p 25-47, 1983. 33 Fig, 4 Tab, 30 Ref.

Descriptors: *Radiochemical analysis, *Laboratory studies, *Leaching, *Heavy metals, *Coal, *Fly ash, Radioactivity techniques, Radioisotopes, Path of pollutants, Radioactive tracers, Isotopic tracers, Ions, Anions.

Assessment of the potential environmental impact of heavy metals (HM) mobilized by coal-fired power plants showed that water leaching of HM from pulverized fuel ash may for certain HM constitute an important pathway to the aquatic environment. Batch experiments simulate ash pond conditions, whereas column experiments represent water leaching from fly ash deposits. Using radioactive tracers and neutron activation of fly ash the fate of a single HM is easily followed even in very low concentrations. Employing radioisotopic tracers the distribution coefficients of simple ionic forms of As, Sb, Bi, Se, Te, Cr, Mo, W, Ni, and Cd in a coal fly ash/water system is determined as a function of pH. The adsorption and desorption behaviour of HM on coal fly is explained in part on the basis of the surface predominance and the aqueous chemistry of single ionic, mainly anionic, forms of the relative elements. Ion exchange and coprecipitation phenomena are also important processes. The nature and concentration of ions contained originally in the water used (distilled water, fly ash leachate and seawater) has a strong influence on the sorptive behavior of HM on coal ashes. (Murphy-IVI)
W84-03374

MODEL OF ION EQUILIBRIUM IN AQUEOUS SOLUTIONS OF FLY ASH IN THE CONTEXT OF PREDICTION OF GROUND AND SURFACE WATER CONTAMINATION,
Instytut Ksztaltowania Srodowiska, Katowice (Poland). Environmental Pollution Abatement Centre.
M. J. Laczny, E. Krop, and M. Polak.
Water Science and Technology, Vol. 15, No. 11, p 239-246, 1983. 3 Fig, 7 Ref.

Descriptors: *Groundwater contamination, *Water pollution sources, Predicting, Fly ash, Model studies, Waste disposal, Computers, Algorithms.

Fly ashes contain readily and poorly soluble compounds which are leached due to water impact and infiltrate into the environment. Considerations of the impact of power waste landfill on the environment of groundwater and surface waters must not only include the quantitative composition of the aqueous solutions, which are in contact with fly ash, but also the kinetic relationships. Based on lab studies conducted on samples taken from the entire cross section of the disposal site, compounds were selected for which a qualitative-quantitative equilbrium model was calculated using electronic computers. The algorithm and equations used in the calculations are presented. The algorithm adopted for the calculation is universal for this type of ion equilbria. New equilibria can be easily introduced to the algorithm. The proposed model permits calculation of the resultant hydrochemical composition of water after mixing of the infiltration water from a landfill site with groundwater or surface waters, provided that the quantity of mixed waters is known. (Baker-IVI)
W84-03381

CHEMICAL PATHWAYS FROM STACK EMISSIONS TO SURFACE WATER,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
A. S. Kallend.
Water Science and Technology, Vol. 15, No. 12, p 9-21, 1983. 4 Fig, 4 Tab, 26 Ref.

Descriptors: *Fate of pollutants, *Chemical reactions, Water pollution sources, Air pollution, Sulfur dioxide, Nitrogen oxides, Precipitation.

A complex chain of processes links the production of an anthropogenic atmospheric emission with its action in the aqueous environment. The importance of chemical transformations was examined in determining the impact of atmospheric emissions on the aquatic environment through precipitation. Special attention was given to chemical kinetics. Direct measurements as well as modelling studies based on kinetic parameters determined in the lab have resulted in a reasonable understanding of the gas phase chemical transformation of major primary pollutants. The relative abundance of sulfate and nitrate in precipitation does not, however, reflect the measured or predicted rate of production of nitric acid and sulfate aerosol in typical plumes in which gas phase chemistry predominates and suggests that, on the average at least, in-cloud chemical transformation along with direct precipitation scavenging accounts for a substantial part of the sulfate actually observed in precipitation at most sites. The chemical interaction of pollutants from the same source and from different sources is brought out most clearly when considering the effect of ambient air composition on the gas phase chemistry in plumes. However, oxidant availability during in-cloud oxidation of sulfur dioxide may be of even greater importance and may sometimes be the rate determining factor for sulfate production. The chemistry of the ambient air is also important at long range, particularly when it is of urban origin because this air itself contains many of the principal components that are also present in power plant plumes including sulfur dioxide, nitrogen oxides and their derivatives. To be both soundly based and cost-effective any future control strategy must likewise rely on a thorough understanding of the chemical pathways linking source and effect and on the resolution to further research of the areas of uncertainty. (Baker-IVI)
W84-03383

TRANSPORT OF AIRBORNE MERCURY EMITTED BY COAL BURNING INTO AQUATIC SYSTEMS,
Swedish Water and Air Pollution Research Lab., Goeteborg.
C. Brosset.
Water Science and Technology, Vol. 15, No. 12, p 59-66, 1983. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *Mercury, *Path of pollutants, Coal, Water pollution sources, Air pollution, Precipitation, Coal combustion, Sweden.

Faced with the possibility of increased use of coal for energy production the Swedish government decided some years ago to sponsor a comprehensive investigation of all kinds of emissions connected with the combustion of coal and their eventual impact on the environment. One of the problems to be elucidated emphasized the consequences of the emission of mercury. Concentrations of water soluble and insoluble mercury compounds in air, precipitation and smoke from coal combustion have been measured. A concentration of total airborne mercury at remote places in southwestern Sweden was found to amount to 2-4 ng/cubic m. About 20% of it is probably anthropogenic. As the concentration in this fraction is proportional to the concentration of soot particles it is probably emitted in connection with coal burning. The total airborne mercury includes a water soluble fraction of 10-20%. A big part of this last fraction (about 80%) has stability properties indicating organic mercury compounds, possibly methyl mercury salts. The smoke from coal burning seems to have a similar composition. However, its water soluble concentration fraction may be near 70%. This fraction can be easily wet or dry deposited into aquatic systems. (Baker-IVI)
W84-03386

SULPHUR AND CHLORIDE DEPOSITION AND ECOSYSTEM TRANSPORT IN A STRONGLY ACIDIFIED LAKE WATERSHED,
Swedish Water and Air Pollution Research Lab., Goeteborg.
H. Hultberg, P. Grennfelt, and B. Olsson.
Water Science and Technology, Vol. 15, No. 12, p 81-104, 1983. 11 Fig, 10 Tab, 11 Ref.

Descriptors: *Sulfur, *Chloride, *Deposition, *Path of pollutants, *Acidic lakes, Watersheds, Acidic water, Chemical properties, Acid precipitation, Sweden, Ecosystems.

Field monitoring during a two-year period of concentrations in air, precipitation, streams and lakes, attempts to synthesize deposition and ecosystem transport of sulfur and chloride through a strongly acidified lake watershed on the Swedish west coast. The dry deposition estimate from concentra-

tion measurements and deposition estimate from concentration measurements and deposition velocities were in good agreement with monitored outflows. The estimated sulfur deposition to areas with coniferous forests was 25-31 kg/ha per year and to lake areas was 19 kg/ha per year. The marine part of the input is about 10%. The estimated retention of sulfur in the total watershed is 8-21%. (Murphy-IVI)
W84-03388

THE EFFECTS OF COAL COMBUSTION AND ACIDIFICATION ON THE CADMIUM EXPOSURE OF THE SWEDISH POPULATION,
Studsvik Energiteknik A.B., Nykoeping (Sweden).
L. Ramberg.
Water Science and Technology, Vol 15, No. 12, p 105-113, 1983. 3 Fig, 21 Ref.

Descriptors: *Cadmium, *Water pollution sources, Path of pollutants, Fertilizers, Industrial wastes, Sweden, Coal, Coal combustion, Burning, Air pollution.

A model has been developed and applied for release situations of cadmium which might occur in Southern and Middle Sweden. The model describes these areas of Sweden as composed of three compartments: forests, crop land, and lakes. The cadmium input to this simplified description of the biosphere comes from atmospheric precipitation, fertilizers and industrial releases to water as well as from coal combustion. The model is limited to an analysis of the large turnovers of cadmium on a long time scale in a sector of the biosphere and the mean health effects on the population as a whole. Cadmium balance and mobility in crop soils controls the cadmium flow to man. The atmospheric precipitation of cadmium is of dominant importance for controlling future exposures. The use of phosphorous fertilizers containing Cd may be harder to mitigate as alternatives are not well developed. (Baker-IVI)
W84-03389

HISTORICAL CHANGES IN ACID PRECIPITATION AND HEAVY METALS DEPOSITION ORIGINATING FROM FOSSIL FUEL COMBUSTION IN EASTERN NORTH AMERICA AS REVEALED BY LAKE SEDIMENT GEOCHEMISTRY,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Ouellet, and H. G. Jones.
Water Science and Technology, Vol. 15, No. 12, p 115-130, 1983. 6 Fig, 2 Tab, 53 Ref.

Descriptors: *Acid rain, *Heavy metals, *Deposition, *Fossil fuel, *North America, *Lake sediments, *Geochemistry, Fuels, Tantare Lake, Laflamme Lake, Air pollution, Mercury, Lead, Zinc, Water pollution sources.

The sediments of remote 'undisturbed' lakes more accurately reflect any changes in atmospheric fallout from air masses originating from outside the watershed. The geochemical stratigraphic evolution of two soft water lakes (Tantare and Laflamme) reveal that the allochthonous inputs will dominate any changes in total inputs. The increase in Al in the sediments of Lake Tantare since about 1950 is attributed to the processes of surface water acidification of this watershed induced by acid precipitation. The analogous upper strata of the sediments from Lake Laflamme, a non-acidified lake, show no such increase in Al content. Pb, Zn and Hg levels in the sediments increased significantly from 1940 onwards. The subsequent reduction in the stratigraphic concentration of Zn since 1960 in both Lake Tantare and Lake Laflamme is, in all probability, the result of the important decrease of the total particulate emissions to the atmosphere from coal-fired plants. The same phenomenon may also explain Hg decrease during the same period. In contrast, Pb shows no such reduction in the more recent strata and the sustained increase of this element in the sediments is attributed to the progression in motor vehicle activity during the past twenty years. Further data from other isolated lakes suggest that the major sources of heavy metal deposition and acid precipitation in the Province of Quebec are the emissions from fossil fuel combustion (coal and/or motor fuel) originating in the heavily industrialized American Midwest and Great Lakes Regions. (Murphy-IVI)
W84-03390

MINE DRAINAGE AND ROCK TYPE INFLUENCES ON EASTERN OHIO STREAM WATER QUALITY,
Geological Survey, Reston, VA.
D. R. Helsel.
Water Resources Bulletin, Vol. 19, No. 6, p 881-887, December, 1983. 2 Fig, 3 Tab, 15 Ref.

Descriptors: *Acid mine drainage, *Rock properties, *Ohio, *Streams, *Water pollution sources, Geochemistry, Land reclamation, Base flow, Land use, Groundwater pollution.

Stream water during fair weather (base flow) is largely ground water discharge, which has been in contact with minerals of the underlying aquifer. Base flow water quality should therefore reflect aquifer mineralogy as well as upstream land use. Three upstream mining categories (unmined lands, abandoned coal mines, and reclaimed coal mines) differed in pH, specific conductance, sulfate, iron, aluminum, and alkalinity for 122 streams in eastern Ohio. Aquifer rock type influenced pH, specific conductance, sulfate, iron, and alkalinity. Reclamation returned many components of acid mine drainage to near unmined levels, although sulfate and specific conductance were not improved. Acid mine drainage problems were less severe in watersheds underlain by the calcareous Monongahela Formation. These results should apply to other Appalachian coal regions having similar rock units. The water quality data distributions were neither consistently normal nor lognormal. Statistical tests utilizing ranks of the water quality data, instead of the data themselves, provided useful in analyzing the influences of mining category and rock type. (Author's abstract)
W84-03391

LOADING FUNCTIONS FOR PREDICTING NUTRIENT LOSSES FROM COMPLEX WATERSHEDS,
Clemson Univ., SC. Dept. of Agricultural Economics and Rural Sociology.
L. L. D. Delwiche, and D. A. Haith.
Water Resources Bulletin, Vol. 19, No. 6, p 951-959, December, 1983. 1 Fig, 8 Tab, 27 Ref.

Descriptors: *Water pollution sources, *Nonpoint pollution sources, *Nutrients, *Watersheds, Mathematical models, Load function, Croplands, Forests, Urban areas, Animal wastes, Effluents, Groundwater discharge, West Branch Delaware River, New York.

A loading function methodology is presented for predicting runoff, sediment, and nutrient losses from complex watersheds. Separate models are defined for cropland, forest, urban and barnyard sources, and procedures for estimating baseflow nutrients are provided. The loading functions are designed for use as a preliminary screening tool to isolate the major contributors in a watershed. Input data sources are readily available and the functions do not require costly calibrations. Data requirements include watershed land use and soil information, daily precipitation and temperature records and rainfall erosivities. Comparison of predicted and measured water, sediment, and nutrient runoff fluxes for the West Branch Delaware River in New York, indicated that runoff was underpredicted by about 14% while dissolved nutrients were within 30% of observed values. Sediment and solid-phase nutrients were overpredicted by about 50%. An annual nutrient budget for the West Branch Delaware River showed that cornland was the major source of sediment, solid-phase nutrients, and total phosphorus. Waste water treatment plants and ground water discharge contributed the most dissolved phosphorus and dissolved nitrogen, respectively. (Author's abstract)
W84-03400

THROUGHFALL PH: EFFECT OF PRECIPITATION TIMING AND AMOUNT,
Commonwealth Scientific and Industrial Researc
Organization, Canberra (Australia). Div. of Wat
and Land Resources.
I. D. Moore.
Water Resources Bulletin, Vol. 19, No. 6, p 96
965, December, 1983. 3 Fig, 23 Ref.

Descriptors: *Hydrogen ion concentration, *Pr
cipitation, *Throughfall, *Acid rain, Bufferin
Deciduous forests, Canopy, Dryfall, Leaves, Ke
tucky.

Precipitation, throughfall, and stream pH we
measured weekly over a 27-week period in 1982 c
the Little Millseat watershed in eastern Kentuck
The average pH values over the study period we
4.3, 4.9, and 6.4, respectively, indicating significa
buffering as water moved from the atmospher
through the deciduous canopy, and through
over the soil to the stream. Regression analys
demonstrated that the timing and amount of pr
cipitation were important factors influencing th
pH of the throughfall. Weekly precipitation a
the three-week average precipitation were statis
cally significant variables, explaining 53% of th
variance in the observed throughfall pH. Precipit
tion pH was not a statistically significant variab
for this watershed and sampling period. Durin
dry periods with little precipitation, the deciduo
canopy had a high buffering capacity and throug
fall pH remains high (about 6.0) even though th
precipitation pH is low. As the frequency, duratio
and amount of precipitation increases the bufferi
capacity remains high until the accumulated dr
fall deposition is washed from the leaf surfaces, a
the leaching rates of plant chemicals from th
leaves are exceeded by the supply rate of acid
precipitation. At this time a large volume of acid
precipitation is input to the system with little bu
fering capacity by the canopy, so the throughfa
pH decreases rapidly, approaching that of the in
dent precipitation. After major precipitation ever
it takes some time for the canopy to recover a
for nutrients and plant chemicals to be replaced
the leaves, and for dryfall to build up on le
surfaces before throughfall pH begins to increas
This time delay varied from about one to thr
weeks, depending on the amount of precipitatio
during this recovery period. (Moore-IVI)
W84-03401

**RELATIONSHIP OF NITRATE CONCENTR
TIONS TO DISTANCE OF WELL SCRE
OPENINGS BELOW CASING WATER LEVEL**
Geological Survey, Lawrence, KS. Water R
sources Div.
For primary bibliographic entry see Field 5F.
W84-03403

**USE OF GEOSTATISTICS TO EVALUAT
WATER QUALITY CHANGES DUE TO CO
MINING,**
Science and Education Administration, Universi
Park, PA. Northeast Watershed Research Cent
A. S. Rogowski.
Water Resources Bulletin, Vol. 19, No. 6, p 9
992, December, 1983. 8 Fig, 2 Tab, 6 Ref.

Descriptors: *Water quality, *Coal minin
Groundwater pollution, Variogram, Geostatisti
Environmental effects.

Large variability of water quality data often mak
it difficult to judge whether or not the conditio
in an aquifer or a stream are deteriorating
improving. A technique for separation of var
grams into positive and negative difference comp
nents is proposed. This technique was applied
water quality data from a reclaimed site that h
been used for coal mining. Distribution of grou
water elevations in time at the experimental s
showed that highest water levels on both the str
mined and deepmined areas generally follow t
occurrence of major storms, while lowest lev
appeared to result from 60-day or longer dry spe
with rains less than 25 mm. Despite much scat
and variability in the data, sulfate concentratio
were most highly correlated with other variab
and could be used to estimate each of the oth
chemical parameters for selected sampling sit

Therefore, sulfate concentrations were used to illustrate the novel technique designed to show if the water quality was improving or deteriorating. The results showed conclusively that overall water quality improved on the stripmined and undisturbed area, remained about the same in the deepmined area, and declined in the seep and stream. (Baker-IVI)
W84-03404

ACID SNOWPACK CHEMISTRY IN PENNSYLVANIA, 1979-81,
Pennsylvania State Univ., University Park. School of Forest Resources.
D. R. DeWalle, W. E. Sharpe, J. A. Izbicki, and D. L. Wirries.
Water Resources Bulletin, Vol. 19, No. 6, p 993-1001, December, 1983. 8 Fig, 5 Tab, 16 Ref.

Descriptors: *Snowpack, *Acid precipitation, *Pennsylvania, *Hydrogen ion concentration, Nitric acid, Sulfates, Sulfur dioxide, Dust, Limestone, Dolomite, Quarries, Water pollution sources.

Snowpack chemistry was evaluated with repeated surveys at 30 sampling sites across Pennsylvania during 1979-81. The mean snowpack pH of 4.25 of 280 samples was largely due to H(+) from nitric acid. Snowpack sulfates were high, especially in the southwest sector of the state, where SO2 emissions were also high. Rain-on-snow and coastal storm snowpacks produced higher snowpack pH. Localized increases in snowpack pH were found due to additions of dust from limestone and dolomite quarry operations, especially in the central Ridge and Valley Province. Acid loading on the landscape from snow in Pennsylvania is controlled by the total amount of snowfall as well as variations in concentrations of chemical constituents. (Author's abstract)
W84-03405

EFFECTS OF CLEARCUTTING AND SLASH BURNING ON STREAMWATER CHEMISTRY AND WATERSHED NUTRIENT BUDGETS IN SOUTHWESTERN BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Faculty of Forestry.
M. C. Feller, and J. P. Kimmins.
Water Resources Research, Vol. 20, No. 1, p 29-40, January, 1984. 2 Fig, 8 Tab, 63 Ref.

Descriptors: *Clear-cutting, *Slash burning, *Water chemistry, *Stream pollution, *British Columbia, Nutrients, Water pollution sources, Sodium, Potassium, Magnesium, Chloride, Phosphorus, Calcium, Nitrates.

Two small forested watersheds near Haney in southwestern British Columbia were partially clearcut, and the slash on one of them was subsequently burned. Streamwater chemistry was monitored in these treated watersheds and an undisturbed control watershed for 2 years prior to treatment and up to 9 years after treatment. The chemical parameters that were studied responded differently to the treatments, but there was a general pattern of increased concentrations and fluxes in streamwater for the first 2-3 years following treatment followed by a decline to, and sometimes below, pretreatment values. The most pronounced increases were observed for K and NO3. It was not possible to determine the exact causes of these changes in concentrations and fluxes, due to the great variability in the ecosystems present. This variability precluded determination of statistically significant changes in annual terrestrial nutrient fluxes and pools. Stream nutrient exports usually were <10 kg/ha/yr for each of N, P, K, and Mg, <20 kg/ha/yr for Na and Cl, and <30 kg/ha/yr for Ca. These values were considerably less than nutrient exports in harvested logs and in losses to the atmosphere during the slashburn. Clearcutting and burning caused greater nutrient losses than clearcutting alone, particularly in the case of N, where the clearcutting and clearcutting and burning treatments resulted in total losses of 245 kg/ha and 1293 kg/ha, respectively, for the first two years after treatment. (Author's abstract)
W84-03410

LAND USE PRESSURES ON COASTAL ESTUARIES IN ATLANTIC CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Inst. for Resource and Environmental Studies.
G. E. Beanlands.
Coastal Zone Management Journal, Vol. 11, No. 1-2, p 117-132, 1983. 2 Fig, 8 Tab, 13 Ref.

Descriptors: *Estuaries, *Water pollution sources, *Land use, *Nova Scotia, *New Brunswick, *Prince Edward Island, Water pollution effects, Shellfish, Aerial photography.

Land-use pressures on estuarine resources were studied in the three Maritime Provinces of Canada (Nova Scotia, New Brunswick, Prince Edward Island). The first phase involved the initial identification of estuaries in the study area through stereoscopic interpretation of recent aerial photographs. The second phase involved the determination of land and water uses associated with each estuary. Various human activities were identified on the photographs and classified according to 14 major types of developments. This major breakdown was further refined by the addition of sub-categories related to intensity of use, for a total of 22 development types. The only regionally-based and consistent indicator of the biological quality of nearshore waters, including estuaries, is that provided by the shellfish pollution monitoring program of the federal government. As of 1977, over 200 areas in the Maritime Provinces were closed to the harvesting of shellfish. The incidence of pollution ranges from 80% of those estuaries supporting industrial activity to 47% of those influenced by recreational cottages. Only 17.7% of development-free estuaries were closed to shellfish harvesting. Forty-two percent of the estuaries suppporting one type of use were contaminated compared with 100% contamination of those influence by seven or more types of human activity. Given that 74% of the estuaries in the region have not yet undergone complex and intensive development, every effort should be made to prevent a further deterioration of this valuable resource base before remedial measures are impossible. (Moore-IVI)
W84-03426

OIL AND GREASE IN URBAN STORMWATERS,
California Univ., Los Angeles. School of Engineering and Applied Science.
M. K. Stenstrom, G. S. Silverman, and T. A. Bursztynsky.
Journal of Environmental Engineering, Vol. 110, No. 1, p 58-71, February, 1984. 3 Fig, 9 Tab, 30 Ref.

Descriptors: *Oil, *Grease, *Storm water, *Water pollution sources, *Land use, Rainfall, Water pollution control, Simulation, Richmond, California, San Franciso Bay.

A study of oil and grease in urban stormwaters was performed on a small watershed in Richmond, California, with the objective of determining the amount of oil and grease discharged into San Francisco Bay. Five sampling stations were selected at various places in the watershed that were indicative of specific land uses, and runoff from seven storms was samples and analyzed. The results of the survey indicated that oil and grease concentration was highly dependent upon land use, ranging from 4.1 mg/L in residential areas to 15.3 mg/L in parking lots. A statistical analysis of oil and grease and storm characteristics showed that oil and grease concentration was independent of all storm characteristics, except that mass of oil and grease discharged was proportional to total rainfall. Qualitative analysis of the oil and grease by gas chromatography indicated that it most resembled used automobile crankcase oil. Several samples showed evidence of spills of specific compounds. A simulation of management techniques indicated that a 90% reduction in discharge from commercial properties and parking lots, which represented only 9.6% of the total surface area, would result in a 53% reduction in total oil and grease discharge. Growth simulation predicted a potential 27% increase in discharge if 5% of the watershed were converted from open land to commercial property. (Author's abstract)
W84-03470

HISTORY OF PHOSPHORUS LOADING TO ONONDAGA LAKE,
Allied Corp., Jamesville, NY.
S. P. Devan, and S. W. Effler.
Journal of Environmental Engineering, Vol. 110, No. 1, p 93-109, February, 1984. 10 Fig, 2 Tab, 45 Ref.

Descriptors: *Phosphorus, *Onondaga Lake, *New York, Phytoplankton, Nutrients, Fate of pollutants, Lake restoration, Water pollution control, Calcium, Eutrophication, Sediments, Pollution load, Lake Ontario.

The history of phosphorus loading to, and efflux from, Onondaga Lake, New York, is presented for a 12-yr period (1970-1981), during which several phosphorus management measures were taken. A ten-fold reduction in phosphorus loading since 1970 has been achieved through implementation of reclamation measures, which included a ban on high phosphorus detergents and the addition of secondary and tertiary processes at the adjoining sewage treatment plant. Significant reductions in lake phytoplankton concentrations have not accompanied the reduction in phosphorus loading, indicating the lake remains nutrient-saturated. An unusually high fraction of phosphorus received by the lake is retained, apparently as a result of enhanced phosphorus deposition associated with the industrial loading of calcium from an adjoining chloralkali manufacturer. One-tenth of the reported substantial reduction in phosphorus loading to Lake Ontario from 1970-1979 is attributable to the reduction in loading to Onondaga Lake. The nature of the phosphorus associations in the lake's sediments indicates that sediment interactions should not act to compensate for further reductions in external phosphorus loading. (Author's abstract)
W84-03471

CADMIUM ADSORPTION BY AEROBIC LAKE SEDIMENTS,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
J. O. Wiley, and P. O. Nelson.
Journal of Environmental Engineering, Vol. 110, No. 1, p 226-243, February, 1984. 9 Fig, 7 Tab, 51 Ref.

Descriptors: *Cadmium, *Lake sediments, *Adsorption, Fate of pollutants, Hydrogen ion concentration, Ligands, Sediments, Iron, Manganese, Partical size, Chemical speciation, Suspended solids, Organic compounds.

Factors that influence the adsorption of cadmium on aerobic lake sediments were investigated, including sediment type, pH, and soluble ligand composition. Conditional adsorption constants were experimentally determined for sediments samples in native lake water from Sturgeon Lake, Oregon. Correlation of adsorption constant values with sediment characteristics including mean grain size, iron and manganese content, volatile solids content, and cation exchange indicated significant dependence only on mean grain size. Another approach, using specific geochemical phase adsorption constants from another study to assess that phase's contribution to adsorption, predicted that iron oxides controlled cadmium adsorption. A speciation-distribution model for cadmium in the water column indicated that the dominant chemical forms were the free cadmium ion and cadmium adsorbed to suspended solids. As pH increased from 5 to 9, the adsorbed fraction increased and the free ionic fraction decreased markedly. Organic ligand complexes were predicted to be the dominant soluble cadmium complex in the neutral pH range, while the cadmium carbonate dominated at pH 9. (Author's abstract)
W84-03477

CRITICAL POINT METHOD FOR MIXING ZONES IN RIVERS,
Gore and Storrie Ltd., Toronto (Ontario). Water Resources Div.
T. P. H. Gowda.

Journal of Environmental Engineering, Vol. 110, No. 1, p 244-261, February, 1984. 9 Fig, 4 Tab, 23 Ref.

Descriptors: *Mixing, *Path of pollutants, *Critical point, Effluents, Chlorine, Ammonia, Outfalls, Rivers.

Expressions for the coordinates of a critical point, occurring along a given lateral boundary of a limited use zone within a mixing zone below a bank outfall in a river channel, are developed. A family of curves is developed for a range of dimensionless coordinates of the critical point. An expression for allowable effluent concentration of a pollutant is obtained in terms of critical concentration and water quality criterion. A graphical procedure for determining the longitudinal boundary of a limited use zone is described. The predictions of the critical point method are validated using total residual chlorine distribution data from a natural stream. The application of the methodology is outlined in a step-by-step design procedure and illustrated by an example for ammonia. In general, the method is applicable to exponentially decaying nonconservative pollutants. (Author's abstract)
W84-03478

ELEVATED CONCENTRATIONS OF HUMIC SUBSTANCES IN A SEASONALLY ANOXIC HYPOLIMNION: EVIDENCE FOR CO-ACCUMULATION WITH IRON,
Freshwater Biological Association, Ambleside (England).
E. Tipping, and C. Woof.
Archiv fur Hydrobiologie, Vol. 98, No. 2, p 137-145, October, 1983. 4 Fig, 2 Tab, 24 Ref.

Descriptors: *Decomposing organic matter, *Hypolimnion, Thermal stratification, Seasonal variations, Iron, Accumulation, Sediments, Algae, Iron oxide, Esthwaite Water, Fate of pollutants.

Humic substances (HS) are a major fraction of soluble organic matter in natural waters. They influence the chemical speciation of metals, bind hydrophobic pollutants such as DDT, and play a significant role in environmental surface chemistry. HS are a potential hazard in waters used for domestic supply since they react with chlorine to yield trihalomethanes, possible carcinogens. For these reasons, factors which determine humic concentrations in natural waters are of wide relevance. Increases in the concentration of humic substances in the anoxic hypolimnion of Esthwaite Water are correlated with increases in the concentration of iron. This finding supports the theory of a mechanism whereby humic substances are accumulated by co-sedimentation with iron oxide particles. Subsequently the humic substances follow the movements of iron during its redox cycling in the hypolimnion and sediment. Unsuccessful attempts were made to distinguish epilimnetic and hypolimnetic humic substances by spectroscopic and gel chromatographic means. Therefore no evidence for an alternative mechanism of humic accumulation was found such as the anaerobic decomposition of sedimented dead algae. (Baker-IVI)
W84-03488

ENDOGENIC FLUX OF MANGANESE TO THE BOTTOM OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Fakultaet fuer Physik.
H.-H. Stabel, and J. Kleiner.
Archiv fur Hydrobiologie, Vol. 98, No. 3, p 307-316, November, 1983. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Manganese, *Fate of pollutants, *Bottom sediments, Lakes, Lake Constance, Sedimentation, Hypolimnion, Thermal stratification.

The manganese content of the sediment particles trapped at greater depths was generally enhanced relative to that found in the upper layers. Three reasons may be responsible for this. Degradation of oganic matter during the settling process, and redissolution of calcite in deeper layers may lead to a relative enrichment of more stable inorganic constituents. Resuspension of bottom sediments richer in Mn than the particles moving vertically from upper layers may occur. In addition, an eodogenic oxidation of Mn(2+) into Mn(4+) occurs within the hypolimnion of Lake Constance. The Mn(4+) precipitates, mainly gamma-MnOOH, add to the vertical flux of Mn-containing particles, deriving from planktonic and allochthonous sources. (Baker-IVI)
W84-03493

5C. Effects Of Pollution

THE RECOVERY OF THE BIOTIC COMMUNITY IN A LOTIC FRESHWATER HABITAT AFTER EXTENSIVE DESTRUCTION BY CHLORINE,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 2, p 207-226, 1983. 2 Fig, 2 Tab, 25 Ref.

Descriptors: *Biotic recovery, *Lotic environment, *Chlorine, Ecological effects, Aquatic populations, Population dynamics, Population exposure, Fauna, Residual chlorine.

The recovery of a temperate zone biotic community in a lotic freshwater habitat after acute chlorine poisoning was nearly completed in four months (May to September). The water flow facilitated the removal of the toxic residues of the chlorine and transported organisms from the intact community upstream into the impoverished habitat. The first aggregation in the ditch after the chlorine was eliminated consisted of survivors, including members of species that failed to produce new generations. These were joined by pioneer species of the families Simulidae and Chironomidae, the larvae of which appeared in massive numbers. This aggregation was displaced by a more diverse fauna as the macroflora and microbiota re-established themselves, providing food and anchorage for the invertebrates. The populations of large fishes are slowest to return because a considerable amount of time is required for the migration and growth of the recruits. While the chronic intoxication of a habitat produces changes in community structure, an acute poisoning is followed by a nearly complete restoration of the original biota, the recovery time being determined by the proximity of recruits for resettlement. (Murphy-IVI)
W84-02951

THE DISTRIBUTION OF DESMOGNATHINE LARVAE (AMPHIBIA: PLETHODONTIDAE) IN COAL SURFACE MINE IMPACTED STREAMS OF THE CUMBERLAND PLATEAU, USA,
Tulsa Univ., OK. Faculty of Natural Sciences.
For primary bibliographic entry see Field 2H.
W84-02961

THE DESMIDS AND PHYSICAL CHARACTERISTICS OF 100 LAKES IN NORTHEASTERN PENNSYLVANIA,
Wilkes Coll., Wilkes-Barre, PA.
For primary bibliographic entry see Field 2H.
W84-02962

THE DISTRIBUTION AND ACCUMULATION OF ALUMINUM IN RAINBOW TROUT FOLLOWING A WHOLE-LAKE ALUM TREATMENT,
Eastern Washington Univ., Cheney. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W84-02963

AN INDEX OF COMMUNITY STRUCTURE SENSITIVE TO WATER POLLUTION,
Georgia State Univ., Atlanta. Dept. of Biology.
F. K. Parrish, and J. A. Wagner.
Journal of Freshwater Ecology, Vol. 2, No. 2, p 103-107, July, 1983. 2 Tab, 7 Ref.

Descriptors: *Benthic environment, *Water pollution effects, Macroinvertebrates, Invertebrates, Population dynamics, Species diversity, Wate quality.

To quantify pollutional stress utilizing macroinver tebrate community composition, an average ch square test was used with considerable succes The method is presented for further testing. conceptually simple index, the average chi-squar value, is presented which compares and ranks po luted vs unpolluted streams within a geographi area. It uses all data from a sample, requires onl that comparable or equal numbers of samples b used to compare two sites and provides a summar value which has been found to give consistentl satisfactory results. (Baker-IVI)
W84-02966

LAKE ONTARIO'S FISH - HOW THE ALMOST GOT AWAY,
S. Peterson.
Environment, Vol. 25, No. 9, p 25-32, Novembe 1983. 6 Fig, 32 Ref.

Descriptors: *Fish, *Water pollution effects, *Lak Ontario, Great Lakes, Polychlorinated biphenyl Dioxin, Mirex, Salmon, Fisheries, Pesticides, Lam prey, Alewife, Smelt.

The history of fish populations in Lake Ontario reviewed. Two hundred years ago the lake su ported what has been thought to be the world largest population of land-locked salmon. By th end of World War II practically all commerciall valuable fish species in this lake were gone. Cu rently sportsmen again are catching trophy siz chinook salmon in that lake, but now these fish a contaminated with pollutants which renders the unsafe for consumption more than once a mont and unsafe for children and women of child bea ing age in any amount. As lands bordering Lak Ontario were cleared and settled, nearly ever sizable stream was dammed in order to pow industrial mills. Dams and pollution took their to on the lake population. The next happening w direct exploitation by developing gill-net fisheri One of the most dramatic results of man's impa on the Great Lakes has been the spectacular su cess of several invading marine species of fis which have profoundly altered the ecology of th lakes. Among these are the lamprey, alewife an smelt. The presence in the lake of PCBs, dioxin and mirex are of particular concern to area re dents and fish managers. (Baker-IVI)
W84-02985

NICKEL TOXICITY TO ESTUARINE/MARIN FUNGI AND ITS AMELIORATION BY MA NESIUM IN SEA WATER,
New York Univ., NY. Lab. of Microbial Ecolog
H. Babich, and G. Stotzky.
Water, Air, and Soil Pollution, Vol. 19, No. 2, 193-202, 1983. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Seawater, *Nickel, *Toxicit *Fungi, Sodium, Chloride, Magnesium, Salinit Mycelial, Marine plants, Estuarine environmen

Mycelial growth rates of five estuarine/mari fungi were determined on the non-marine and the marine nutrient medium in the absence a presence of progressively increasing levels nickel. In the absence of nickel growth rates we greater on the marine medium. Furthermore, t fungi tolerated nickel better when exposed on t marine than on the non-marine medium. Wh grown on the non-marine medium amended wi nickel, incipient growth inhibition for Pleospo vagens was evident at a concentration between and 50 ppm Ni for Dendryphiella salina, Aster myces cruciatus, and Dreschlera halodes at 50 pp nickel, and for Buergenerula spartinae at a conce tration greater than 50 ppm Ni. Total grow inhibition on the non-marine medium occurred 50 ppm Ni for P. vagens, at 100 ppm Ni for salina, B. spartinae, and A. cruciatus, and at 2 ppm Ni for D. halodes. When grown on t marine medium, incipient growth inhibition o curred at 50 ppm Ni for P. vagens, A. cruciat and D. halodes, at 100 ppm Ni for D. salina, and 250 ppm Ni for B. spartinae. Total growth inhi

ion occurred at 500 ppm Ni for P. vagens, D. alina, B. spartinae, and A. cruciatus, and D. hodes exhibited some growth even at 500 ppm Ni. The ameliorating effect of seawater or salinity on he toxicity of Ni to mycelial proliferation was related to the Mg, rather than to the Na or Cl ions n the marine systems. The mechanism by which eawater reduced Ni toxicity is apparently different from the mechansism whereby seawater reduced the toxicity of Cd and Hg. (Baker-FRC)
W84-02988

STUDIES ON BACTERIOLOGICAL QUALITY OF NAINITAL LAKE WATER IN DIFFERENT SEASONS,
Kumaun Univ., Naini Tal (India). MAB/DST Lakes Project.
For primary bibliographic entry see Field 5B.
W84-02989

POTENTIAL PHYTOTOXICITY OF DIQUAT ACCUMULATED BY AQUATIC PLANTS AND SEDIMENTS,
York Univ., Downsview (Ontario). Dept. of Biology.
B. C. Birmingham, and B. Colman.
Water, Air, and Soil Pollution, Vol. 19, No. 2, p 123-131, 1983. 2 Fig, 4 Tab, 24 Ref.

Descriptors: *Phytotoxicity, *Aquatic plants, *Sediments, *Organic compounds, Herbicides, Diquat, Bipyridilium, Lake sediment, Bottom sediment, Bioassays, Water pollution effects.

The adsorption and desorption of Reglone A was studied on freshwater algae grown in culture, Eurasian water milfoil, and greenhouse soil-sand mixture. The data was needed to examine the potential for phytotoxicity of diquat residues in aquatic ecosystems. The nitrogen fixing blue-green alga, Anabaena flos-aquae and a duckweed were used as bioassay organisms to test for residual phytotoxicity once the diquat was bound to the soil. Reglone inhibited the growth of blue-green algae at concentrations greater than 0.03 ppm. Eukaryotic algae were less sensitive, growth of Navicula pelliculose was inhibitied at concentrations exceeding 0.3 ppm and Chlorella vulgaris was unaffected by 3 ppm Reglone. In the presence of soil, growth inhibition by Reglone was eliminated. Reglone was added to a water-soil mixture system up to 334 ppm to simulate chronic usage. Significant growth inhibition occurred to both bioassay plants in soil treated with 33.4 ppm Reglone and the 334 ppm treatment was lethal. It is suggested that residual phytotoxicity becomes apparent in this soil system at about 7% of the diquat adsorption capacity. The Reglone adsorption-desorption isotherm of a natural, organic lake sediment was measured to predict the number of Reglone treatments at the recommended application rate before residual phytotoxicity would become apparent. (Baker-FRC)
W84-02990

DELAYED TOXICITY OF CARBOFURAN IN FRESHWATER TELEOSTS, CHANNA PUNCTATUS (BLOCH) AND ANABAS TESTUDINEUS (BLOCH),
Visva Bharati Univ., Santiniketan (India). Environmental Toxicology Lab.
N. B. Jash, and S. Bhattacharya.
Water, Air, and Soil Pollution, Vol. 19, No. 3, p 209-213, 1983. 2 Tab, 10 Ref.

Descriptors: *Toxicity, *Organic compounds, *Pesticides, *Fish, Water pollution effects, Organophosphates, India, Aquatic life.

In vitro inhibition of brain acetylcholinesterase from Channa punctatus and Anabas testudineus was compared between control and Carbofuran treated fish. A dose dependent in vivo inhibition was recorded in both species of fish. On transfer to pesticide free fresh water there was immediate recovery of AChE activity within 30 days only in those fish treated with the highest dose of Carbofuran. During the sojourn of fish in Carbofuran free water there appears to be a gradual dissociation of the incorporated inhibitor from the enzyme, which occurs at a faster rate in fish treated with highest concentrations of carbofuran. Delayed toxicity of the lower concentrations of carbofuran was more conspicuous in Channa punctatus although it is apparently more resistant to carbofuran than Anabas testudineus. (Baker-FRC)
W84-02992

PERIPHYTON BIOMASS AND SPECIES COMPOSITION IN A COASTAL RAINFOREST STREAM IN BRITISH COLUMBIA: EFFECTS OF ENVIRONMENTAL CHANGES CAUSED BY LOGGING,
Fisheries and Marine Service, Vancouver (British Columbia). Vancouver Lab.
K. S. Shortreed, and J. G. Stockner.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 1887-1895, November, 1983. 6 Fig, 1 Tab, 26 Ref.

Descriptors: *Environmental effects, *Coastal streams, *Logging, *British Columbia, Carnation Creek, Phosphorous, Biomass, Algae, Chlorophyta, Diatoms, Solar radiatior., Periphyton, Clear-cutting, Water temperature.

Periphyton biomass, species composition, and accumulation rates on Plexiglas substrates were determined in a 6-yr study from 1974 to 1979 in Carnation Creek, Vancouver Island, British Columbia. During the first 2 years of the study, the watershed was unlogged. Clearcut logging during the remainder of the study resulted in increases in light intensity of over 100% at some sites, with slight increases in stream temperature (2-3 degrees C in summer) and increases in some dissolved ion concentrations. Phosphorus concentrations were similar throughout. Diatoms were the most common class of algae, and Achnanthes minutissima and Synedra rumpens were the most common diatoms. Filamentous chlorophytes (predominantly Mougeotia sp. with some Draparnaldia sp., Spirogyra and Zygnema sp.) occurred sporadically throughout the study but were more common after logging, primarily as a result of increased light intensity. The highest recorded periphyton biomass and accumulation rates occurred after logging. Post-logging values were generally similar to those recorded prior to logging due to the lack of increased phosphorus concentrations after logging. (Murphy-IVI)
W84-03016

CONTAMINANT ACCUMULATION AND PHYSIOLOGICAL RESPONSE IN RAINBOW TROUT (SALMO GAIRDNERI) REARED ON NATURALLY CONTAMINATED DIETS,
Guelph Univ. (Ontario). Dept. of Nutrition.
J. W. Hilton, P. V. Hodson, H. E. Braun, J. L. Leatherland, and S. J. Slinger.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 1987-1994, November, 1983. 6 Tab, 21 Ref.

Descriptors: *Physiological response, *Trout, *Bioaccumulation, Salmon, Fish food, DDT, Chlordane, Dieldrin, Polychlorinated biphenyls, Aquaculture, Mirex, Lake Michigan, Lake Ontario, Pacific Ocean.

Juvenile rainbow trout were reared for 24 weeks on practical-type diets formulated with fish meals of coho salmon (Oncorhynchus kisutch) from Lake Michigan, Lake Ontario, and the Pacific Ocean. Levels of contaminants (DDT, chlordane, dieldrin, mirex and polychlorinated biphenyls) increased 10-fold from control and Pacific Ocean salmon-based diets to Lake Ontario salmon-based diets. Rainbow trout accumulated contaminants in direct proportion to dietary levels. There were no significantly differences in the final body weights, feed to gain ratios, or mortality rates of the trout. There were no signs of abnormal behavior or histopathological abnormalities. There were no signs of thyroid hyperplasia or significant decline in serum T3 or T4 levels with increasing dietary contaminant levels. The rainbow trout were not affected by the uptake and accumulation of contaminants. The trout did not regulate their body burden of contaminants, which could be toxic and adversely affect their reproductive cycle. The final concentrations of mirex and PCBs in Lake Ontario-fed fish exceeded the allowed limits to protect human health. The fish meals produced from Lake Ontario salmon are unsuitable as a source of feed for aquaculture of rainbow trout intended for human consumption. (Murphy-IVI)
W84-03018

GEOTHERMAL EFFECTS ON STREAM BENTHOS: SEPARATE INFLUENCES OF THERMAL AND CHEMICAL COMPONENTS ON PERIPHYTON AND MACROINVERTEBRATES,
California Univ., Berkeley. Div. of Entomology and Parasitology.
G. A. Lamberti, and V. H. Resh.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 1995-2009, November, 1983. 8 Fig, 3 Tab, 40 Ref. OWRT project A-084-CAL, Water Resources Center Project UCAL-WRC-W-612.

Descriptors: *Benthos, *Thermal springs, *Environmental effects, *Geothermal fluids, *Stream biota, Thermal stress, Chemical composition, Invertebrates, Geothermal power, Big Sulphur Creek, The Geysers, California.

The largest geothermal energy development in the world is located at The Geysers in northern California, but the full development of geothermal resources at The Geysers and in other areas has been delayed because of potential environmental impact, especially on aquatic biota. Stream microcosms were used in situ to evaluate the separate effects of the thermal and chemical components of geothermal fluids from natural hot springs on benthic microorganisms and macroinvertebrates of Big Sulphur Creek, a third-order stream at The Geysers. The thermal component of geothermal fluids had greater influence than the chemical component in determining benthic community features. A natural input of geothermal fluids elevated both the temperature (by 7.5 degrees) and chemical levels (boron by 10 times, NO3-N by 4 times, PO4-P by 2 times), increased benthic chlorophyll a by 40 times, bacterial numbers by 10 times, and macroinvertebrate density by 2 times. Heating of non-geothermal water by 8 degrees increased chlorophyll a by 40 times and bacterial numbers by 2 times, but macroinvertebrate density declined by one fourth. Cooling of geothermal water by 14.5 degrees reduced algal productivity but increased macroinvertebrate density by 70 times. Naturally occurring geochemical concentrations apparently can be tolerated by aquatic organisms, but changes in water temperature significantly alter benthic community structure. (Murphy-IVI)
W84-03019

INFLUENCE OF DETERIORATING WATER QUALITY ON GROWTH AND DEVELOPMENT OF CHUM SALMON (ONCORHYNCHUS KETA) LARVAE IN A JAPANESE-STYLE KEEPER CHANNEL,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
R. A. Bams, and C. N. H. Lam.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 11, p 2098-2104, November, 1983. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Water pollution effects, *Salmon, *Larvae, *Keeper channels, Aquaculture, Growth, Dissolved oxygen, Fish farming, Ammonia.

Chum salmon (Oncorhynchus keta) larvae were incubated in gravel filled cages placed in two experimental Japanese-style keeper channels having 40 and 80 L/min total flow, at three successive locations having 0, 46,000, and 92,000 eggs (or alevins) upstream. Minimum dissolved oxygen was 6.21 mg/L. Maximum un-ionized ammonia was 0.18 microgram/L. The pH varied from 7.18 to 6.83, and temperature ranged from 7.8 to 8.2 C. Preemergent fry showed small but significant decreases in mean fork length, with increasing distance along both channels 50 days after hatching. Weights decreased similarly but nonsignificantly in both channels. Stage of development was constant in all locations except the bottom location of the

low-flow channel, which showed a significantly delay. Survival was uniformly high with no differential mortality among locations or flow rates. The deteriorating water quality measurably reduced larval development rate, growth rate, and yolk-conversion efficiency. The main effective factor was dissolved oxygen. Standard channel loading and flow criteria are adequate for short incubation channels only. (Murphy-IVI)
W84-03020

ACUTE EFFECTS OF TOXAPHENE AND ITS SEDIMENT-DEGRADED PRODUCTS ON ESTUARINE FISH,
South Carolina Univ., Columbia.
H. W. Harder, T. V. Carter, and T. F. Bidleman.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p 2119-2125, December, 1983. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Toxaphene, *Estuarine environment, *Toxicity, *Fish, Degradation products, Pesticide residues, Sediments, Bioassay, Bioaccumulation.

The acute effect of toxaphene and the dechlorinated products that are formed in reducing sediments were determined for two estuarine fish, spot (Leiostomus xanthurus) and white mullet (Mugil curema). The reductively dechlorinated mixture was prepared by incubating toxaphene with anoxic salt marsh sediment for three weeks and isolating the products, then analyzed by packed and glass capillary gas chromatography. The 96-h LC50 for toxaphene was 0.92 and 2.88 micrograms/L for spot and mullet, respectively. Sediment degraded toxaphene was almost as toxic to spot (LC50 = 1.10 microgram/L) as the parent pesticide. The mullet were three times more susceptible to the degraded form (LC50 = 1.02 microgram/L). Bioaccumulation was similar for both forms of toxaphene, with factors of 2000-6000 over the 96-h exposure period. Short-term degradation of toxaphene in anoxic sediments does not apear to reduce its toxicity; the degraded toxaphene produced has as much potential for causing acute poisoning to fish as the parent pesticide. Analytical searches for toxaphene residues in environmental samples should not be restricted to gas chromatography patterns matching those of the parent compound but should also consider the degraded toxaphene fingerprints. (Murphy-IVI)
W84-03021

RETROSPECTIVE ANALYSIS OF THE RESPONSE OF SAGINAW BAY, LAKE HURON, TO REDUCTIONS IN PHOSPHORUS LOADINGS,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
V. J. Blerman, Jr., D. M. Dolan, R. Kasprzyk, and J. L. Clark.
Environmental Science and Technology, Vol. 18, No. 1, p 23-31, January, 1984. 7 Fig, 5 Tab, 40 Ref.

Descriptors: *Saginaw Bay, *Lake Huron, *Phosphorus, Biomass, Chlorophyll a, Phytoplankton, Cyanophyta, Turbidity, Sediment resuspension, Odor, Drinking water.

Control of phosphorus inputs to lakes is one of the principal means for attempting to reverse the symptoms of cultural eutrophication. Through a retrospective (1974-1980) analysis of Saginaw Bay, Lake Huron, loadings to the bay from the Saginaw River for total phosphorus and dissolved ortho phosphorus were 55% and 72% lower, respectively, in 1980 than in 1974. In the most seriously degraded area of the bay, spring and fall total phosphorus concentrations decreased by 1% and 14%, respectively, while chlorophyll a concentrations decreased by 53% and 61% in the same seasons. The corresponding decreases for inverse Secchi depth were 0% and 17%. Sediment resuspension due to wind-induced wave action was the probable cause for the anomalous relationship between chlorophyll a and total phosphorus concentrations, and the lack of response of inverse Secchi depth. A substantial decrease in threshold odor in the municipal water supply was correlated with a decrease in blue-green dry weight biomass concentration. The change was poorly correlated with blue-green cell number, total phytoplankton dry weight biomass, or chlorophyll a concentrations. (Murphy-IVI)
W84-03033

FISH/SEDIMENT CONCENTRATION RATIOS FOR ORGANIC COMPOUNDS,
Harvard School of Public Health, Boston, MA. Interdisciplinary Programs in Health.
M. S. Connor.
Environmental Science and Technology, Vol. 18, No. 1, p 31-35, January, 1984. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Fish, *Sediments, *Organic compounds, Chlorinated hydrocarbons, Hydrocarbons, Water pollution effects, Mollusks, Crustaceans, Mathematical studies, Partition coefficients, Hydraulic retention time, Flushing capacity.

Applying a bioconcentration factor directly to predict the potential for the contamination of fish by toxic organic compounds may be insufficient in the field. Partition coefficients make accurate predictions of contamination in short-term laboratory tests, but in the environment, biological and physical factors play an important role. The concentration ratio of chlorinated or polynuclear aromatic hydrocarbons in fish to the sediments from their habitat increases with hydraulic retention time of the basin. Fish/sediment ratios for chlorinated hydrocarbons are about three orders of magnitude higher than for aromatic hydrocarbons with the same octanol-water partition coefficient. Normalizing for sediment concentrations and animal concentrations of chlorinated aromatic hydrocarbons, the body burdens of polynuclear aromatic hydrocarbons in different phyletic groups are consistent with the inverse of their mixed-function oxygenase activity. The order for the concentrations is mollusks > polychaetes = crustaceans > fish. The consistent behavior of classes of compounds allows extrapolation from data for individual compounds to a variety of pollutants in aquatic environments where the flushing capacity has been determined. (Murphy-IVI)
W84-03034

CHEMISTRY AND MICROBIOLOGY OF A SEWAGE SPILL IN SOUTH SAN FRANCISCO BAY,
Geological Survey, Menlo Park, CA.
J. E. Cloern, and R. S. Oremland.
Estuaries, Vol. 6, No. 4, p 399-406, December, 1983. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Wastewater, *Spills, *Water pollution effects, Bays, San Francisco Bay, Estuaries, Wastewater treatment facilities, Primary wastewater treatment, Secondary wastewater treatment, Dissolved oxygen, Methane, Ammonia.

The breakdown of a waste treatment plant resulted in the discharge of a large volume of primary treated sewage into a tributary of South San Francisco Bay, California during three weeks of September 1979. Chemical and microbial changes occurred within the tributary as decomposition and nitrification depleted dissolved oxygen. Associated with anoxia were relatively high concentrations of particulate organic carbon, dissolved carbon dioxide, methane, C2H2, ammonia and fecal bacteria along with low phytoplankton biomass and photosynthetic oxygen production. After the sewage treatment plant resumed its normal activities the Coyote Creek experienced radical biochemical changes as it shifted from anaerobic to aerobic conditions. Most rapid changes were noted in CH4 and C2H4 concentrations. Within two weeks particulate organic carbon decreased and dissolved oxygen increased to apparently normal levels. The rapid chemical changes were accompanied by increases in phytoplankton biomass. Two principles associated with the discharge of sewage into estuaries were exemplified by the study: first, the finite capacity of receiving waters to assimilate wastes, and secondly, that the aquatic ecosystems are resilient, even to extreme perturbations. (Baker-IVI)
W84-03038

EFFECTS OF INDUSTRIAL BOILER BLOWDOWN DISCHARGES ON STREAMS,
Tennessee Dept. of Public Health, Nashville.
J. C. Spangler.
Pollution Engineering, Vol. 25, No. 9, p 44-45, 1983. 2 Fig.

Descriptors: *Wastewater treatment, *Monitoring, Acidity, Sulfites, Sulfates, Dissolved solids, Oxygen demand, Suspended solids, Boiler blowdown.

Boiler blowdown is primarily for elimination of boiler sludge and dissolved solids. Before the blowdown is discharged, it should be treated to comply with effluent guidelines instead of diluting the discharge with other discharges. The following parameters are recommended for monitoring and reporting on an individual case basis for boiler blowdown discharges to other than publicly owned treatment works: biochemical oxygen demand, total suspended solids, total dissolved solids, pH, sulfites, chemical oxygen demand, settleable solids, ammonia, oil and grease, and sulfates. (Baker-IVI)
W84-03051

PREDICTING ALGAL STIMULATORY PROPERTIES OF WASTEWATER,
Massachusetts Univ., Amherst.
N. M. Ram, and P. E. Austin.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1099-1110, October, 1983. 6 fig, 2 Tab, 19 Ref. WDWPC project 80-30.

Descriptors: *Prediction, *Algae, *Biological properties, *Wastewater, Municipal Sewage, Inorganic nitrogen, Inorganic phosphorus, Algal growth, Biodegradation.

Discharge of wastewater effluent into the aquatic environment is of environmental concern because of the resulting eutrophication or nutrient of receiving waters leading to decreased water quality. The Algal Assay: Bottle Test (AA:BT) is a useful tool in evaluating the bioavailable nutrients in natural waters and wastewater effluents. The AA:BT did not permit sufficient organic mineralization during incubation, owing to the exclusion of heterotrophic bacteria and protozoa by the test procedure. This occurrence could result in an underestimation by the AA:BT of the algal growth potential occurring from the entry of a wastewater containing inorganic and organic nitrogen and phosphorus compounds into the aquatic environment. (Murphy-IVI)
W84-03089

TEMPERATURE, PH, SALINITY, HARDNESS AND PARTICULATES MEDIATE NICKEL TOXICITY TO EUBACTERIA, AN ACTINOMYCETE, AND YEASTS IN LAKE, SIMULATED ESTUARINE, AND SEA WATERS,
New York Univ., NY. Lab. of Microbial Ecology
H. Babich, and G. Stotzky.
Aquatic Toxicology, Vol. 3, No. 3, p 195-208, April, 1983. 10 Fig, 24 Ref. EPA grant R808329.

Descriptors: *Temperature, *Hydrogen ion concentration, *Salinity, *Hardness, *Particulate matter, *Nickel, *Toxicity, *Eubacteria, *Actinomycete, *Yeasts, *Lakes, *Estuarine environment, *Seawater, Heavy metals, Water pollution effects, Water quality standards, Environmental factors.

Little is known about the effects of Ni on marine microorganisms. Even less is known about the influence of abiotic environmental factors on the toxicity of Ni to marine organisms, especially to the microbiota. Information on the survival of some eubacteria, an actinomycete, and yeasts after acute and chronic exposures to nickel (Ni) in lake, simulated estuarine, and sea waters and the influence of environmental factors on Ni toxicity will help to determine water quality standards. Criteria that do not adequately consider differences in the physicochemical characteristics of various aquatic ecosystems will be over-protective for some ecosystems and under-protective for others. Nickel toxicity to microbes in marine systems is reduced by increasing the salinity, by decreasing the temperature, and by the incorporation of simulated

ediment. The toxicity of Ni to microbes in fresh vater is reduced by increasing the pH, by increasng the hardness, and by the incorporation of susended particulates. In chronic toxicity fresh vaters are more sensitive than marine waters to Ni ollution, as microbial survival is greater in marine han in fresh waters stressed with equivalent conentrations of Ni. (Murphy-IVI)
V84-03111

RAINBOW TROUT AND HUMAN CELLS IN CULTURE FOR THE EVALUATION OF THE TOXICITY OF AQUATIC POLLUTANTS: A STUDY WITH CADMIUM,
Quebec Univ., Montreal. Dept. de Chemie.
M. Marion, and F. Denizeau.
Aquatic Toxicology, Vol. 3, No. 4, p 329-343, May, 1983. 4 Fig, 28 Ref.

Descriptors: *Rainbow trout cells, *Human cells, *Toxicity, *Aquatic pollutants, *Cadmium, Bioassay, Bioaccumulation, Detection limits, Water quality, Comparison studies, Correlation analysis.

Rainbow trout (RTG-2) and human skin epithelial cells (NCTC 2544) as bioassay organisms evaluated he toxicity of the aquatic pollutant cadmium (Cd). The cell lines were grown as monolayers at 15 RTG-2) and 37 degree C (NCTC 2544) in minimal ssential medium supplemented with 10% fetal ovine serum (FBS). RTG-2 and NCTC 2544 cells xposed to 100 ppb and 2.4 ppm Cd was mainained for a period of time sufficient for an inocuum of 105 cells (RTG-2) or 50,000 cells (NCTC 544) to reach confluence in the controls in a 60-m Petri dish: 20 days for RTG-2 and 9 days for NCTC 2544. Every 2 days (RTG-2) or every day NCTC 2544) the medium was renewed and 3 Petri dishes were used to determine the total proein, total DNA, total RNA content and the incorporation of H-3 thymidine in DNA and C-14 uriine in RNA. The cytotoxicity of Cd was apparent nly when the serum concentration in the medium vas reduced. With 1% FBS in the medium Cd nduced a dramatic inhibition in the increase of otal protein DNA and RNA content of RTG-2 ells. At 2.4 ppm, this occurred as early as 5 days protein and RNA) after Cd was added to the ultures. The incorporation of labelled precursors vas equally much lower in the treated samples (2.4 ppm) compared to the controls. At 100 ppb, only he incorporation of C-14 uridine in RNA was ffected after 10 days of exposure and persisted ntil the end of the experiment. NCTC 2544 cells ppeared to be more sensitive to cadmium than RTG-2 cells. At 2.4 ppm, as seen with trout cells, here was a severe depression in all the parameters. However, at 100 ppm, contrasting with RTG-2 ells, significant differences were at least on 4 arameters (protein, DNA, RNA and C-14 incorporation). The complete assessment of the reliabilty of cell culture systems for the evaluation of oxicity will be achieved through the establishment f a strong correlation between in vivo and in vitro esponses. This is considered an important step in he process of validation of the present bioassay ystem. (Murphy-IVI)
W84-03114

EFFECTS OF ACCUMULATED DIETARY KEPONE ON SPOT (LEIOSTOMUS XANTHURUS),
Virginia Inst. of Marine Science, Gloucester Point.
L. L. Stehlik, and J. V. Merriner.
Aquatic Toxicology, Vol. 3, No. 4, p 345-358, May, 1983. 5 Fig, 11 Tab, 33 Ref.

Descriptors: *Bioaccumulation, *Diets, *Kepone, *Spot, Biological effects, Fish toxins, Mortality, Water pollution effects.

The water, sediments and biota of the James River, n Virginia, are contaminated with organochlorine esticide Kepone (Chlordecone). Migratory fish ccumulate Kepone while they reside in the James River during the summer. The administration of Kepone on juvenile spot body burdens increased additively and equilibrium was not attained. When spot were fed a lethal concentration (3.3 micrograms/g) over 28 days, they accumulated an average of 2.7 micrograms/g (wet wt). Most developed muscular tetany, fractured vertebral centra, and abnormally thickened vertebrae. These symptoms developed over a 4-wk period until death. Spot fed lesser concentrations (0.59 and 0.30 microgram/g) accumulated 0.7 and 0.3 microgram/g over 56 days and developed similar bone damage. The percentage of collagen in vertebrae was significantly greater in the treated fish which had thickened bones. Spot that were held in the laboratory as controls for 5 wk had significantly lower collagen percentages than wild fish. Kepone accumulation is the likely mechanism for production of the bone deformities observed in fishes from the James River in 1971-1976. (Murphy-IVI)
W84-03115

RELATIVE LIVER WEIGHTS AND XENOBIOTIC-METABOLIZING ENZYMES OF FISH FROM POLLUTED SURFACE WATERS IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
W. Slooff, C. F. Van Kreijl, and A. J. Baars.
Aquatic Toxicology, Vol. 4, No. 1, p 1-14, August, 1983. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Liver weights, *Xenobiotic compounds, *Metabolizing enzymes, *Fish toxins, *Water pollution, *Surface water, *Netherlands, Chemical wastes, Bioaccumulation, Bioindicator, Biological effects, Rhine River.

Organisms inhabiting the river Rhine are exposed to a wide variety of foreign organic chemicals. From laboratory experiments it is known that exposure to xenobiotic compounds often results in liver enlargement, usually associated with the induction or stimulation of hepatic enzyme activities. The somatic liver index (SLI) values were significantly greater in populations sampled from contaminated waters than in those from less polluted areas. The highest values from Rhine fish were (3.5) and the lowest for Lake Braassem fish were (1.5). Both biochemical and histological observations suggest that the liver enlargement is mainly caused by hypertrophy. The liver growth was accompanied by elevated hepatic enzyme activities. Like most other liver parameters, the SLI showed seasonal variations with the highest values in winter and the lowest in spring. Over the past 3 years there has been a decrease of the relative liver weight of Rhine and Meuse fish in time, which may reflect the improvement of the chemical water quality of these rivers. The SLI may be useful as an indicator of chemical water pollution. (Murphy-IVI)
W84-03116

TOXICITY OF CYANOBACTERIA IN DUTCH LAKES AND RESERVOIRS,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicology.
For primary bibliographic entry see Field 2H.
W84-03117

BENTHIC MACROINVERTEBRATES AND WATER QUALITY ASSESSMENT: SOME TOXICOLOGICAL CONSIDERATIONS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
W. Slooff.
Aquatic Toxicology, Vol. 4, No. 1, p 73-82, August, 1983. 3 Tab, 35 Ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Water quality, *Toxicity, Water quality standards, Bioindicator, Chemical wastewater.

The distribution of benthic macroinvertebrates is generally considered to be indicative for the chemical quality of surface waters. However, little is known about their tolerance to chemical pollutants. To give further information on the tolerance of macrobenthos to toxic conditions of surface water, the susceptibility of invertebrate species of different taxonomical groups (Oligochaeta, Diptera, Hirundinea, Isopoda, Gastropoda, Tricladida, Hydrozoa, Heteroptera, Amphipoda, Odonata, Trichoptera, Ephemeroptera, Plecoptera) to 15 chemical compounds and to a mixture of organics concentrated from river Rhine water was determined in acute toxicity tests. The tolerance of macroinvertebrate species are pollutant-specific, whereas the differences in their susceptibility to toxic conditions due to pollution by several toxicants may be negligibly small. Therefore, the reliability of using biological systems based on the macrobenthos distribution to classify surface waters polluted with a variety of chemical pollutants should be seriously doubted. (Murphy-IVI)
W84-03118

THE EFFECT OF TWO TRIAZINE HERBICIDES ON THE PRODUCTIVITY OF FRESHWATER MARSH PERIPHYTON,
Manitoba Univ., Winnipeg. Dept. of Botany.
L. G. Goldsborough, and G. G. C. Robinson.
Aquatic Toxicology, Vol. 4, No. 2, p 95-112, September, 1983. 6 Fig, 4 Tab, 37 Ref.

Descriptors: *Ecological effects, *Triazines, *Herbicides, *Periphyton, Marsh plants, Environmental impact statement, Aquatic productivity, Simazine, Terbutryn.

Simazine has been widely used in lake management and fish culture for the control of undesirable macrophytic species and nuisance phytoplankton blooms. Terbutryn has recently been demonstrated to possess stronger algicidal properties than similar levels of other triazines. The colonization of acrylic substrata by periphyton is monitored by measuring chlorophyll a accumulation and carbon assimilation rate, with varying concentrations of the aquatic herbicides simazine and terbutryn added to in-situ enclosures of marsh water. There was no change, relative to an untreated control, at 0.1 mg/l simazine, with increasing inhibition (to approximately 95%) at 1.0 and 5.0 mg/l. Chlorophyll a and carbon assimilation reduced >90% with terbutryn concentrations of 0.01 ml/l and higher. With factor analysis periphytic productivity correlated with water chemistry, light availability, time and the experimental herbicide treatment. This suggests that herbicidal effects result from a complex interaction of several parameters rather than herbicide concentration alone. Recovery of the communities following decreased herbicide concentrations began within 1 wk, with growth rate equal to or greater than the control. The longterm impact of a single dosage of these herbicides on a periphyton community may be minimal. (Murphy-IVI)
W84-03119

THE MICROTOX* AS AN ALTERNATIVE ASSAY IN THE ACUTE TOXICITY ASSESSMENT OF WATER POLLUTANTS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
D. De Zwart, and W. Slooff.
Aquatic Toxicology, Vol. 4, No. 2, p 129-138, September, 1983. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Beckman Microtox Assay System, *Bioassay, *Toxicity, *Pollutants, Comparison studies, Water quality control, Bioluminescence, Bacteria, Algae, Protozoans, Crustaceans, Insects, Coelenterates, Mollusks, Fishes, Amphibians.

The Beckman Microtox Assay System (MAS) is based on the production of light per unit time by living luminescent bacteria, which is a reflection of the rate at which a complex set of energy-producing reactions is operating. Standard toxicity tests usually require 48 to 96 h of testing, and take about 10 h of actual work including the troublesome task of breeding test organisms. The MAS produces representative data in about 0.5 h, which can be considered as a primary test to quickly determine which compounds yield certain risks for the aquatic environment. In this way the standard bioassays could be limited to those samples which warrant further analysis. Mean deviation from the mean of two duplicate tests on each of three different chemicals is found to be about 10%. For some compounds the 15-min EC values were > 10% higher than the corresponding 5-min values. The MAS yielded fairly replicable results which were

comparable wih those obtained with the standard tests. As the MAS does not require the culturing of test organisms and takes about 5% of the actual work involved in the standard procedures, the MAS should be used as a prescreening tool in the hazard assessment of chemicals. (Murphy-IVI)
W84-03120

MONITORING THE RIVERS RHINE AND MEUSE IN THE NETHERLANDS FOR TOXICITY,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
W. Slooff, D. De Zwart, and J. F. J. Van De Kerkhoff.
Aquatic Toxicology, Vol. 4, No. 2, p 189-198, September, 1983. 3 Fig, 2 Tab, 27 Ref.

Descriptors: *Monitoring, *Rhine River, *Meuse River, *Netherlands, *Toxicity, Organic compounds, Bioindicators, Water quality control, Mutagenicity, Surface water.

In the rivers Rhine and Meuse hundreds of potentially hazardous chemical compounds have been identified, usually at low conentrations. Although their presence has been related to chronic effects in fish in both controlled laboratory experiments and field studies, such investigations are too time-consuming to be applicable in routine monitoring programs. Therefore, short-cut biological methods are needed for water quality control, complimentary to chemical monitoring techniques. Samples concentrated by adsorption on XAD followed by elution with acetone, proved to be at least as effective in concentrating organic toxicants from river water as liquid-liquid extraction or freeze-drying. Generally, Rhine water samples were more toxic than those of Meuse water. On one Rhine location on a weekly basis, toxicity was found to vary with the seasons by more than a factor of 12. It is best to incorporate such toxicity screening tests next to chemical analyses in surveillance programs of water quality. Additionally, the biological significance of the mutagenic activity previously observed in Rhine water concentrates in a 6-month test on P. reticulata, had no effects at concentration factors < or = to 10. There were partial effects in a 33 times greater concentration (impaired swimming performance, hypertrophy of the liver, mortality). At concentration factors > or = to 100 mortality occurred rapidly. there were no apparent tumors. The hazard resulting from the chemicals responsible for the mutagenic activity is not the production of cancers, but, if real, the reduction of the fitness of the exposed populations as a result of an increased genetic load. (Murphy-IVI)
W84-03121

SUBLETHAL EFFECTS OF TREATED LIQUID EFFLUENT FROM A PETROLEUM REFINERY. III. AVOIDANCE AND OTHER LOCOMOTOR RESPONSES OF RAINBOW TROUT,
Department of the Environment, Dartmouth (Nova Scotia).
G. F. Westlake, J. B. Sprague, R. J. Hines, and I. T. Brown.
Aquatic Toxicology, Vol. 4, No. 3, p 235-245, November, 1983. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Sublethal effects, *Treated water, *Petroleum refinery effluent, *Fish behavior, *Rainbow trout, Petroleum industry, Water quality standards, Effluents.

None of the rainbow trout (Salmo gairdneri) in a chamber with side-by-side flows of clean water and 0, 1, 10, or 30% oil refinery effluent, with a steep gradient between the two flows, had statistically significant avoidance or preference behavior. Similarly, the side of entry of the effluent was not related to any differences in relative activity in the four areas. When 30% effluent was present, the general level of activity in all parts of the chamber appeared to be lower than activities for the other concentrations, but the difference was at the borderline of statistical significance (P=0.06). Behavioral response to the effluent was less important than direct physiological effects on trout previously documented with the same effluent. The batches of effluent had an overall 3-day LC50 of about 100% effluent. The effluent exceeded Canadian regulations in average level of ammonia, was somewhat elevated in oil-plus-grease and residue, but was well below regulatory limits for phenols and sulfides. (Murphy-IVI)
W84-03122

SUBLETHAL EFFECTS OF TREATED LIQUID EFFLUENT FROM A PETROLEUM REFINERY. IV. RESPIRATORY MOVEMENTS AND COUGHING OF RAINBOW TROUT,
Environmental Protection Service, Dartmouth (Nova Scotia).
G. F. Westlake, J. B. Sprague, and I. T. Brown.
Aquatic Toxicology, Vol. 4, No. 4, p 317-325, December, 1983. 2 Fig, 1 Tab, 21 Ref.

Descriptors: *Sublethal effects, *Treated water, *Petroleum refinery effluents, *Fish behavior, *Rainbow trout, Bioindicator, Petroleum industry, Effluents, Bioassay, Toxicity, Respiration, Water quality standards, Monitoring.

There have been many studies of lethal levels of refinery effuent to aquatic organisms, but there is almost no published work that establishes the degree of sublethal toxicity. Without such research, there is no way of predicting whether a regulatory effort is likely to produce 'safe' conditions in receiving water. Rainbow trout increased the frequency of gill irrigation in linear relation to the concentration of treated refinery effluent. Full-strength effluent resulted in a significantly higher frequency than in clean water, but 50% and lower did not, because of variation in response. Coughing rate increased sharply and was less variable. A concentration of 50% effluent caused significantly more coughs than in clean water, while 25% did not. The eight samples of effluent caused little lethality at full strength, and average physicochemical characteristics were near or below Canadian regulatory limits, except for elevated oil and grease. Coughing rate shows promise as a rapid initial method for sublethal screening or monitoring of refinery effluents. (Murphy-IVI)
W84-03123

SUBLETHAL EFFECTS OF TREATED LIQUID EFFLUENT FROM A PETROLEUM REFINERY. V. REPRODUCTION OF DAPHNIA PULEX AND OVERALL EVALUATION,
Environmental Protection Service, Dartmouth (Nova Scotia).
G. F. Westlake, J. B. Sprague, and D. W. Rowe.
Aquatic Toxicology, Vol. 4, No. 4, p 327-339, December, 1983. 3 Fig, 2 Tab, 29 Ref.

Descriptors: *Sublethal effects, *Treated water, *Petroleum refinery effluent, *Population dynamics, *Daphnia, Comparison studies, Evaluation, Population exposure, Bioindicator, Bioassay, Toxicity, Reproduction, Monitoring, Water quality standards, Effluents, Oil refineries.

Despite the worldwide occurrence of oil refineries, and much concern about regulating their discharges into surface waters, there is almost no research on sublethal effects of a real refinery effluent on aquatic organisms. The 48-h LC50 of treated refinery effluent for 2-day-old Daphnia pulex was 76% effluent. The 14-day LC50 was 6.4% effluent and this was a threshold value for mortality. For reproductive failure, the 14-day EC50 was 3.1% effluent, and the EC5 of 0.52% effluent was considered to approximate the threshold of sublethal effect. Daphnia reproduction was the most sensitive response in a series of studies that included fish growth, reproduction, locomotion, and respiration. Results are considered representative for a well-treated effluent from a petroleum refinery. The 48-h lethal test with D. pulex would be a useful tool for monitoring or assessing such effluents, since it is simple, small-scale, quick, and about 2.6 times as sensitive as a lethal test with trout. (Murphy-IVI)
W84-03124

OVERLAP AND POLLUTION-INDUCED VARIABILITY IN THE FEEDING HABITS OF FILEFISH (PISCES: MONACANTHIDAE) FROM APALACHEE BAY, FLORIDA,
Florida State Univ., Tallahassee. Dept. of Biological Science.
W. H. Clements, and R. J. Livingston.
Copeia, No. 2, p 331-338, May, 1983. 5 Fig, 3 Tab, 40 Ref. EPA grant R-805288010.

Descriptors: *Water pollution effects, *Fish behavior, *Variability, *Filefish, *Apalachee Bay, *Florida, Estuaries, Estuarine fisheries, Spatial distribution, Temporal distribution, Pulp wastes, Ecological effects.

The impact of pollution on feeding habits and trophic structure is not well known. Changes in the distribution and abundance of prey resulting from disturbances will often be refleted in a predator's diet. The spatial and temporal distribution and feeding habits of two species of filefish, Monacanthus ciliatus and Stephanolepis hispidus, overlap broadly. An apparent similarity in diet reduced when prey were identified to species. Ontogenetic variation of each species had a tendency toward herbivory with increasing standard length. The feeding habits of M. ciliatus taken from areas affected by pulp mill effluents were different than those from a nearby unpolluted estuary. Cluster analysis of stations within the two systems, based on feeding habits of M. ciliatus, were similar to those based on numbers of fishes and macrophyte biomass. Differences in the feeding habits between the two systems may be due to pollution-induced habitat modifications and resulting changes in prey distribution. This may represent an additional method of assessing the effects of pollution. (Murphy-IVI)
W84-03132

ECOLOGY OF PLANKTONIC LARVAE OF DREISSENA POLYMORPHA (PALL.) IN LAKES WITH DIFFERENT DEGREE OF HEATING,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
K. Lewandowski, and J. Ejsmont-Karabin.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 2, p 89-101, 1983. 7 Fig, 4 Tab, 28 Ref.

Descriptors: *Ecology, *Larvae, *Dreissena, *Thermal pollution, Epilimnion, Thermal stratification, Powerplants, Cooling water, Thermocline, Mollusks, Mortality, Poland.

The heating of waters in natural water bodies is an effect of the operation of electric power stations which use the water for cooling purposes. The Konin Lakes complex (Poland), heated by Konin and Patnow power stations, is an example of altered ecosystems. The power stations have a problem with mass invasions of Dreissena polymorpha. The planktonic larvae of D. polymorpha were studied during six seasons (1970-1970) in six lakes included in the cooling systems of the electric power stations. They were encountered from April until September, with an earlier appearance by two months in heated lakes than in unheated lakes of the same climatic zone. Most of the larvae (90%) were in the epilimnion of the lakes except for near the discharge of cooling waters to Slesinskie Lake where larvae were abundant in the whole water column. The youngest larvae were most abundant in shallow layers, the older ones in the deeper zone. There were considerable numbers of dead larvae (up to 20 individuals per cu dm) in the studied lakes. There is a high mortality rate due to the heating of the lakes. (Murphy-IVI)
W84-03152

ECOLOGICAL CHARACTERISTICS OF POLI SAPROBIC SECTION OF THE VISTULA RIVER BELOW WARSAW,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
M. Kaniewska-Prus.
Polskie Archwum Hydrobiologii, Vol. 30, No. 2, p 149-163, 1983. 9 Fig, 3 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Vistula, *Poland, Benthos, Water quality, Seasonal varia

tion, Dissolved oxygen, Nitrogen, Phosphates, Oligochaetes, Diptera, Biomass, Eutrophication, Wastewater pollution.

In 1980-81 studies were carried out on chemical changes in water, and numbers and biomass of macrobenthos in the Vistula river (Poland) at various distances from the pollution source (municipal sewage). From chemical analyses the quality of water was estimated by qualitonomic method. Along a section of 25 km in length from the source of pollution the quality of water does not undergo considerable changes. At all four site the water possessed a high oxygen saturation. The concentration of chlorides was also high at all sites. Inorganic nitrogen and phosphate concentrations were highest at the site nearest the pollution source and lowest at the site farthest from it. The water quality, depending on the season, is either very bad, or bad; only sporadically is it of average level. Among benthic animals Oligochaeta are clearly predominant. Tendipedidae were regularly observed and other dipteran larvae were observed sporadically. Both numbers and biomass of benthos varied considerably depending on the season and water quality. The indices of water pollution, as based on numbers and biomass of taxonomic groups of benthic animals have corroborated the high degree of pollution in this section of the river. (Moore-IVI)
W84-03154

OXYGEN CONSUMPTION AND SURVIVAL OF ASELLUS AQUATICUS L. (CRUSTACEA) IN VISTULA RIVER SECTION HIGHLY POLLUTED BY MUNICIPAL SEWAGE,
Polish Academy of Sciences, Warsaw. Inst. of Ecology.
D. Zimakowska-Gnoinska.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 2, p 165-173, 1983. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Water pollution effects, *Asellus, *Vistula, *Poland, Municipal wastewater, Wastewater pollution, Oxygen consumption, Mortality, Crustaceans, Respiratory rate.

The impact of polluted water was determined on oxygen consumption and survival of males of Asellus aquatticus L. in the period March-November 1981. The water was collected from foursites on the Vistula river, in the 25 km section from Bielany sewage collector output to Dziekanow Polski, which is polluted by Warsaw (Poland) municipal sewage. Measurements of respiratory rate were carried out in volumetric respirometers directly after placing animals in the polluted water, and after 24 hr of exposure to the water. Vistula river water has an unfavorable and irreversible effect on A. aquaticus causing augmented respiration and delayed mortality. Experimental animals after exposure to this water for 3 or 24 hours were transferred to a pure environment. Higher mortality was observed in the next 8 months. The differences from the controls were greatest in the group of animals which had been exposed to the most polluted water. (Moore-IVI)
W84-03155

THE COREGONES OF LAKE NEUCHATEL: FISHERY YIELD; AGE AND GROWTH OF INDIVIDUALS CAUGHT BY PROFESSIONAL FISHERMEN (LES COREGONES DU LAC DE NEUCHATEL: RENDEMENT DE LA PECHE; AGE ET CROISSANCE DES INDIVIDUS CAPTURES PAR LES PECHEURS PROFESSIONNELS),
Inspection Cantonale de la Chasse et de la Peche, Neuchatel (Switzerland).
J. C. Pedroli.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 1, p 345-358, 1983. 5 Fig, 1 Tab, 10 Ref, 1 Append.

Descriptors: *Eutrophication, *Coregonus, *Lake Neuchatel, *Switzerland, Growth, Lake fisheries, Commercial fishing, Fish populations.

The fishery of the indigenous Coregonus sp. (whitefish) of Lake Neuchatel (Switzerland) was studied using statistics kept since 1917 and data on length, weight, and age for fish caught at random in 1927-30, 1947/48, and 1978-80. Although the total numbers and weight of C. fera (a fast growing species) are more or less constant, those of C. macrophthalmus (a slow growing species) have diminished by 75%. Compared to other large lakes in Switzerland, the whitefish catch in Lake Neuchatel has been abnormally low for the last 20 yr. A decrease in the number of whitefish and eutrophication of the lake are two factors which have lowered the mean age of the fish and accelerated their growth rate. For 1978-80, the lengths of the fish are more uniform, and the two types are more difficult to distinguish. This may be due to hybridization, but it is more likely that the frequency of lengths per age class are more uniform. (Moore-IVI)
W84-03176

DECLINE OF RED SPRUCE IN THE NORTHERN APPALACHIANS: ASSESSING THE POSSIBLE ROLE OF ACID DEPOSITION,
Pennsylvania Univ., Philadelphia.
A. H. Johnson, and T. G. Siccama.
Tappi Journal, Vol. 67, No. 1, p 68-72, January, 1984. 6 Fig, 31 Ref.

Descriptors: *Spruce, *Acid deposition, *Acid rain, *Appalachian Mountains, Forests, Clouds, Acid mists, Heavy metals, Aluminum, Metals, Plant pathology, Drought, High elevations, Water pollution effects.

High-elevation spruce-fir forests of the eastern U.S. receive particularly high rates of acidic deposition (up to 4 keq of H(+)/ha/yr), vegetation is exposed to highly acidic cloud moisture for up to 2000 h/yr, and very high levels of trace metals have accumulated. Red spruce (Picea rubens) in the northern Appalachians have died in abnormally large numbers over the past two decades without obvious cause. Considerable attention has been focused on the possible role of acid deposition in the decline. Because of the documented accumulation of heavy metals, the high rates of acidic deposition, the prolonged contact with acidic mist, and laboratory evidence that reasonable levels of dissolved aluminum and possibly other metals can alter water movement in red spruce, anthropogenic pollutants may be involved in the red spruce decline. Widespread reports of spruce mortality in the last century following a series of dry summers suggest the possibility that spruce decline could occur in the absence of high levels of acid or metal deposition. (Moore-IVI)
W84-03191

GROWTH OF SALVINIA MOLESTA AS AFFECTED BY WATER TEMPERATURE AND NUTRITION; II. EFFECTS OF PHOSPHORUS LEVEL,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
P. R. Cary, and P. G. J. Weerts.
Aquatic Botany, Vol. 17, No. 1, p 61-70, September, 1983. 4 Tab, 9 Ref.

Descriptors: *Salvinia, *Aquatic weeds, *Temperature effects, *Phosphorus, *Nutrient removal, Nutrients, Water temperature, Growth, Biological treatment.

Salvinia molesta is a free-floating aquatic plant that is native to South America, but is now widely distributed throughout the tropics. The growth of S. molesta, as affected by phosphorus supply and water temperature, was studied in a greenhouse using controlled water temperature baths at 16, 19 and 22 C. For significant responses to the phosphorus treatments to be obtained it was necessary to use P-deficient plant propagules (containing < 0.01% P on a dry matter basis). For these plants the highest relative growth rate and dry matter production occurred at 22 C when they received 10.01 mg PO4-P/l, but this was not significantly different from that of plants receiving 1.01 mg PO4-P/l. Over a period of 21 days for plants receiving 0.02 mg PO4-P/l the biomass increased 4-fold at 19 C and 6-fold at 22 C. In contrast, for plants receiving 10.01 mg PO4-P/l biomass was increased 20-fold at 19 C and 32-fold at 22 C. At the latter temperature, when receiving 60.06 mg PO4-P/l, plants concentrated up to 1.3% of phosphorus on a dry matter basis, suggesting a possible use as a biological filter and purifier of contaminated waters. Water authorities should maintain nutrients below minimum critical levels to prevent explosive growth of this notorious weed. (Moore-IVI)
W84-03192

A STUDY ON THE GROWTH OF SALVINIA MOLESTA MITCHELL IN RELATION TO LIGHT AND TEMPERATURE,
Kurukshetra Univ. (India). Dept. of Botany.
V. Usha Rani, and S. Bhambie.
Aquatic Botany, Vol. 17, No. 2, p 119-124, October, 1983. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Aquatic weeds, *Salvinia, *Solar radiation, *Temperature effects, *Growth, Seasonal variation, Water quality.

Salvinia molesta is a free-floating weed in most of the Indian inland freshwater systems. It adversely affects water quality, decreases aesthetic values and creates problems for rice growers. The effects of light intensity and temperature on the growth of S. molesta were studied under shade and full sunlight conditions. Growth, in terms of increase in fresh weight and number of offshoots produced was significantly different ($P<0.001$) under the two light conditions; it was highest under shade during May-July, and in August-September under full sunlight. From November to March, under both light conditions, growth was reduced and was minimal from December to February in shade and from December to January in full sunlight. Mean relative growth rate (RGR) varied from 0.01 to 0.07 g/g/day. Increase in the fresh weight had a significant positive non-linear relationship with light intensity and atmospheric temperature. However, since there was a significant positive relationship between temperature and light intensity, it was not possible to separate their effects through regression analysis. (Moore-IVI)
W84-03194

IMPACT OF ACIDIFICATION AND EUTROPHICATION ON MACROPHYTE COMMUNITIES IN SOFT WATERS IN THE NETHERLANDS. I. FIELD OBSERVATIONS,
Katholieke Univ., Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W84-03196

CHARR AS INDICATORS OF POLLUTION,
Staatliches Inst. fuer Seenforschung und Fischereiwesen, Langenargen (Germany, F.R.).
J. Hartmann.
Fisheries, Vol. 8, No. 6, p 10-12, November-December, 1983. 1 Fig, 19 Ref.

Descriptors: *Charr, *Bioindicators, *Pollutant identification, Lake Constance, Eutrophication, Hydrocarbons, Heavy metals, Chironomids, Turbellarians, Tubificids.

Lake Constance forms a border between Austria, Switzerland, and West Germany. The lake has been subject to eutrophication in recent decades. Chironomids and turbellarians are two of the three main components of the charr's diet in the lake and these organisms may also be useful as biological indicators. The horizontal distribution of the charr in Lake Constance before and after cultural eutrophication is quite different. Areas where charr are still caught in large numbers today support few tubificids but many chironomids. These habitats are distant from the major towns and sites of affluent waters and sediments and are not severely polluted by hydrocarbons or heavy metals. The distribution of the charr has progressively been constrained to the least disturbed areas of the lake. (Murphy-IVI)
W84-03198

FERTILIZER AND SALTY WATER EFFECTS ON PHASEOLUS,
Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
For primary bibliographic entry see Field 3C.
W84-03239

THE MACROINVERTEBRATE FAUNA OF THE DRAINAGE CHANNELS OF THE GWENT LEVELS, SOUTH WALES,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
P. Clare, and R. W. Edwards.
Freshwater Biology, Vol. 13, No. 3, p 205-225, June, 1983. 7 Fig, 10 Tab, 42 Ref.

Descriptors: *Macroinvertibrates, *Drainage channels, *Gwent Levels, *South Wales, Benthic fauna, Oxygen balance.

From a survey of the fauna at sixty sites in permanent drainage channels of the Gwent Levels during the spring of 1976 and at some of these sites (thirty-three) during the autumn, species and site associations were identified using classification and ordination techniques. Sites in some groups had identifiably similar environmental characteristics and grouping seemed particularly related to the vegetational stage in the hydrosere, water flow and the incidence of salt contamination from the Severn Estuary. Characteristics which were common within particular species groups and which, in part, explained their distributions were: adaptation to low oxygen concentrations, food preferences and dispersal mechanisms. Whilst there was some temporal stability in site groups between the spring and autumn surveys, such associations were not identical. The oxygen status of channels appeared a major factor determining faunal distribution. Twelve sites, representing a range of channel types, were sampled six times in a 12-month period. Far more species were collected within the water column and on plants than in the benthos. Several oligochaetes, e.g. Aulodrilus pluriseta, Dero digitata, Limnodrilus claparedeanus, were not recorded at most sites during the summer probably because of the sustained lack of oxygen at these sites. Three contiguous reaches of channel were maintained during the period March-October 1977 with different plant cover (no Lemna; complete Lemna cover; control with partial Lemna cover). The oxygen status of the reaches was different, that with complete Lemna cover being continuously anaerobic near the channel bed for several months, the control reach which had partial Lemna cover being anaerobic for a shorter period and that with no Lemna being only anaerobic at night. Whilst the distribution of macroinvertebrate species was principally related to this oxygen status, the control reach which was structurally the most complex, having both submerged and floating plants, contained about twice as many species as the other reaches during the summer (collected in the water column and on plants): benthic samples in this and the reach with complete Lemna cover contained only between zero and two species during the period May-September. (Author's abstract)
W84-03289

A MODEL RELATING THE RESULTS OF LOW PH BIOASSAY EXPERIMENTS TO THE FISHERY STATUS OF NORWEGIAN LAKES,
Central Electricity Generating Board, Ratcliffe-on-Soar (England). Ratcliffe-on-Soar Power Station.
K. Sadler.
Freshwater Biology, Vol. 13, No. 5, p 453-463, October, 1983. 5 Fig, 2 Tab, 51 Ref.

Descriptors: *Model studies, *Hydrogen ion concentration, *Bioassay, *Fisheries, *Lakes, *Norway, Water pollution sources, Fate of pollutants, Water quality, Water pollution effects, Trout, Mortality, England.

The acidification of waters has been linked with the loss of fish populations. One of the best studied regions which has been the subject of much concern is Sorlandet (southernmost Norway). Leslie matrices using data from the literature concerning serveral Norwegian brown trout (Salmo trutta) populations estimates their capacity to withstand egg and fry mortalities. These estimates compared with the results of bioassay studies conducted at pH 4.5 and at various calcium concentrations predicts the percentage of trout populations which would be able to survive these conditions. These predictions are in good agreement with the observed fishery status of Norwegian lakes at calcium concentrations <30 microeq/l but above this concentration the recorded status is worse than predicted. Likely causes for this difference are considered to be effects acting on fish older than those used in the bioassay experiments (either mortality or reduction in fecundity possibly due to impaired growth) or the effects of other water quality factors, for example aluminium. These effects need only be fairly slow acting as compared with the egg and fry mortalities so far studied in detail. Thus the discrepancy between predicted and observed results at pH 4.5 and 50 microeq/l calcium could be caused by an additional 80% mortality acting over the 4-8 year period before maturation. An additional factor which could result in the observed fishery status being worse than predicted is temporal variation in water chemistry which is not assessed in the survey of Norwegian lakes. In particular, the adverse conditions occurring at time of snowmelt could be critically important. (Murphy-IVI)
W84-03298

PRIMARY PRODUCTIVITY STUDIES DURING EARLY YEARS OF WEST POINT RESERVOIR, ALABAMA-GEORGIA,
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
D. R. Bayne, J. M. Lawrence, and J. A. McGuire.
Freshwater Biology, Vol. 13, No. 5, p 477-489, October, 1983. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Primary productivity, *West Point Reservoir, *Alabama, *Georgia, Phytoplankton, Fish populations, Population dynamics, Eutrophication, Hydrogen ion concentration, Water quality, Water pollution effects, Water pollution sources, Fate of pollutants.

Phytoplankton density (organisms/ml), standing crop (chlorophyll a mg/sq m) and primary productivity (mg C/m/d) were measured during years 2 (1976) to 5 (1979) after impoundment on West Point Lake. West Point waters had low alkalinity (<0.4 meq/l) and low conductivity (< 75 micros/cm at 20 degrees C) but N and P concentrations typically exceeded those considered apt to cause nuisance blooms of algae. Abiogenic turbidity was normally higher in the upstream areas of the reservoir than in the downstream areas and was several times higher in winter-spring than in summer-autumn due to increased rains and runoff. Primary productivity varied greatly both temporally and spatially. A mean value of 684 mg C/m/d was well within the mesotrophic range and did not approach the highly eutrophic state predicted. Productivity increased from a low of 550 mg C/m/d in 1976 to high of 763 mg C/m/d in 1979. Observed variation in both chlorophyll a and primary productivity was more predictable in the cool (December-March) than in the warm (June-September) season and with plant nutrient data than without it. With plant nutrient data in the cool season 84% and 86% of the variation (R2) in chlorophyll a and productivity, respectively, were accounted for by the regression equations. During the warm season, with plant nutrient data, regression equations accounted for 44% and 68% of the variation in chlorophyll a and productivity, respectively. Higher R2 values in cool seasons resulted from the overriding influence of abiogenic turbidity on phytoplankton communities. (Author's abstract)
W84-03299

COMMUNITY STRUCTURE IN SOME SOUTHERN ENGLISH STREAMS: THE INFLUENCE OF PHYSICOCHEMICAL FACTORS,
University of East Anglia, Norwich (England). School of Biological Sciences.
C. R. Townsend, A. G. Hildrew, and J. Francis.
Freshwater Biology, Vol. 13, No. 6, p 521-544, December, 1983. 8 Fig, 3 Tab, 57 Ref.

Descriptors: *Community development, *England, *Streams, *Physiochemical properties, Hydrogen ion concentration, Water pollution effects, Water pollution sources, Biological properties, Population dynamics, Aquatic fauna.

Low pH and high iron concentration are factors of growing concern to aquatic ecologists. Acidification of surface waters by polluted rainfall is widespread and acute and acid waters always seem impoverished in comparison with systems which are more basic but otherwise similar. Invertebrates and fish were surveyed during October 1976 in thirty-four stony riffle stream sites in Ashdown Forest, Sussex. A variety of physicochemical factors were also measured in an attempt to assess the importance of each in determining the distribution of species and the structure of communities. Three analytical techniques - stepwise multiple regression analysis, ordination and community classification - revealed that the structure of these communities was strongly related to variation in stream pH. Acid sites had low numbers of individuals, low species richness and low equitabilities. Summer temperature and stream discharge also appeared to play significant roles. The pattern of catchment land use has an important bearing on stream pH. In the most acid sites only collectors, shredders and predators occurred. In more basic sites the number of species in collector and predator categories increased and these were joined by grazer/scrapers and filter feeders. A theoretical basis for explaining stream community structure is discussed. (Murphy-IVI)
W84-03300

CONCENTRATIONS OF TOTAL DISSOLVED SOLIDS PREFERRED OR AVOIDED BY ENDANGERED COLORADO RIVER FISHES,
Utah Cooperative Fishery Research Unit, Logan.
R. Pimentel, and R. V. Bulkley.
Transactions of the American Fisheries Society Vol. 112, No. 5, p 595-600, September, 1983. 1 Fig, 3 Tab, 20 Ref.

Descriptors: *Concentrations, *Total dissolved solids, *Fish behavior, *Endangered species, *Colorado River, Dissolved solids, Environmental effects, Squawfish, Humpback chub, Bonytail, Water pollution effects.

Juveniles of three endangered Colorado River fishes were subjected to a gradient of total dissolved solids (TDS) to determine the concentrations that they preferred or avoided. Preferred and avoided TDS concentrations, respectively, for juveniles of Colorado squawfish were 560-1,150 mg/l and greater than 4,400 mg/l, for humpback chub 1,000-2,500 mg/l and greater than 5,100 mg/l, and for bonytail 4,100-4,700 mg/l and less than 560 mg/l or greater than 6,600 mg/l. Colorado squawfish and humpback chubs selected TDS concentrations that were similar to those in waters they now inhabit, but bonytails selected concentrations four times higher. Future increases of TDS in the Colorado River system would degrade municipal, industrial, and agricultural water used before these endangered fishes would be affected. (Murphy-IVI)
W84-03314

TEMPERATURE PREFERENCE AND AVOIDANCE BY ADULT RAZORBACK SUCKERS,
Utah Cooperative Fishery Research Unit, Logan.
R. V. Bulkley, and R. Pimentel.
Transactions of the American Fisheries Society Vol. 112, No. 5, p 601-607, September, 1983. 1 Fig, 2 Tab, 36 Ref.

Descriptors: *Temperature, *Fish behavior, *Suckers, Temperature effects, behavior, Colorado River, Fish conservation, Fish management, Environmental effects, Dam effects.

Final thermal preferendum for the razorback sucker (Xyrauchen texanus), a rare endemic species of the Colorado River basin, was between 22 and 24.8 C based on electronic-shuttlebox studies. Upper and lower avoidance temperature ranges from 27.4 to 31.6 C and from 8.0 to 14.7 C

espectively. Lower, but not upper, avoidance emperature was positively correlated with accli- ation temperature. The lower aviodance temper- ture and thermal preferenda support the theory at temperature change was involved in the disap- earance of razorback suckers and three other ative endangered species form the tailwaters of laming Gorge Reservoir on the Green River, Jtah. New water-control structures on the upper Colorado River drainage should be designed to rovide summer water temperatures between 22 nd 25 C if preservation of habitat for this species a consideration. (Murphy-IVI)
V84-03315

MORTALITY OF WALLEYE EGGS AND RAINBOW TROUT YOLK-SAC LARVAE IN LOW-PH WATERS OF THE LACLOCHE MOUNTAIN AREA, ONTARIO,
Trent Univ., Peterborough (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W84-03316

ALTERATIONS IN GILL EPITHELIAL MORPHOLOGY OF YEARLING SUNAPEE TROUT EXPOSED TO ACUTE ACID STRESS,
Maine Cooperative Wildlife Research Unit, Orono.
C. H. Jagoe, and T. A. Haines.
Transactions of the American Fisheries Society, Vol. 112, No. 5, p 689-695, September, 1983. 3 Fig, 2 Tab, 36 Ref.

Descriptors: *Fish, *Acidity, *Water pollution effects, Trout, Acid rain, Mortality, Maine, Hydrogen ion concentration.

Gill filaments of hatchery-reared yearling Sunapee trout Salvelinus alpinus oquassa that had been exposed to acute acid stress in static water bioassays were examined by scanning electron microscopy. Fish exposed to acidified water at pH levels above those that caused acute mortality showed little alteration in gill morphology. Exposure to acutely lethal levels of acidity caused considerable damage to gill epithelia, including primary lamellar swelling, increasingly rugose secondary lamellar surfaces, increased mucus production, and fusion of adjacent secondary lamellae. The loss of microridge patterns on the epithelia of the secondary lamellae became more severe with decreasing pH. Such changes may decrease the surface area avaiable for gas exchange and contribute to the anoxia that appears to be an important source of mortality in very low pH levels. (Baker-IVI)
W84-03317

ACUTE TOXCITY OF AMMONIA TO RAINBOW TROUT,
Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, and R. C. Russo.
Transactions of the American Fisheries Society, Vol. 112, No. 5, p 696-704, September, 1983. 1 Fig, 5 Tab, 15 Ref. EPA grants R800861, R803950 and CR807240.

Descriptors: *Ammonia, *Trout, Fish, Toxicity, Water pollution effects, Acclimatization, Dissolved oxygen.

The acute toxicity of ammonia to hatchery-reared rainbow trout was measured in 86 flow-through tests, ranging from 96 hours to 35 days in length. Fish ranged in age from 1 day old fry to 4 yr old adults. The 96 hour median lethal concentrations ranged from 0.16 to 1.1 mg/liter unionized ammonia. Susceptibility to ammonia decreased as the fish developed from sac fry to juveniles, and increased thereafter. Acute toxicity decreased as temperature increased over the range 12 to 19 degrees C. No significant differences in toxicity were observed in tests with different ammonium salts including ammonium chloride, ammonium bicarbonate, ammonium phosphate and ammonium sulfate. The LC50 values obtained for 12- and 35-day tests were not appreciably different from those obtained for tests of shorter time periods. (Baker-IVI)
W84-03318

CHRONIC EFFECTS OF COAL-LIQUID DISPERSIONS ON FATHEAD MINNOWS AND RAINBOW TROUT,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
D. D. Dauble, S. A. Barraclough, R. M. Bean, and W. E. Fallon.
Transactions of the American Fisheries Society, Vol. 112, No. 5, p 712-719, September, 1983. 1 Fig, 3 Tab, 16 Ref. USDE contract DEAC06-76RLO 1830.

Descriptors: *Fish, *Water pollution effects, *Phenols, Coal-liquification, Trout, Minnows, Mortality, Toxicity, Organic compounds, Bioassay.

Fathead minnows and rainbow trout were used in partial-life-cycle bioassays under continuous-flow regimes, with water soluble fractions (WSFs) derived from a coal liquid. Phenols constituted 95% of the organic carbon in stock WSFs. Growth of larval fathead minnows was significantly reduced at 0.25 mg/liter total phenols as determind by dye photometry. At 1.27 mg/liter total phenols, spawning of adult fathead minnows was inhibited and was significantly reduced at 0.62 mg/liter total phenols. Spawning inhibition was not permanent at these concentrations. Fathead minnow pairs resumed spawning 21 days after transfer to control water. The minimal concentration of WSFs that caused significant mortality to rainbow trout depended on the length of time exposed. A 14 day exposure to concentrations equal to or greater than 2.98 mg/liter total phenols was fatal to all rainbow trout embryos due to either egg mortality or premature hatching. Rapid mortality was noted in swim-up rainbow trout after 28 days exposure to 0.13 mg/liter total phenols. Death was partially attributed to clogging of the gills by fungal growth. Possible changes in the composition of water-soluble components occur due to chemical and biological degradation, making long term toxic effects of complex organic mixtures difficult to predict based on dilution of known constituents. (Baker-IVI)
W84-03319

PHENOL TOLERANCE IN POPULATIONS OF MOSQUITOFISH FROM POLLUTED AND NONPOLLUTED WATERS,
Alabama Univ. in Birmingham. Dept. of Biology.
R. A. Angus.
Transactions of the American Fisheries Society, Vol. 112, No. 6, p 794-799, November, 1983. 2 Tab, 7 Ref.

Descriptors: *Fish behavior, *Phenols, *Water pollution effects, Organic compounds, Mosquitofish, Fish, Mortality, Industrial wastes, Lake Purdy, Valley Creek, Alabama.

Fish populations in polluted streams, if not driven to local extinction, may adapt to certain toxic substances over time. Adaptation may involve physiological acclimation if previous exposure has led to the induction of detoxification enzyme systems. The phenol tolerances of three Alabama populations of mosquitofish were compared. Two of the populations lived in industrially polluted streams and one in a nonpolluted lake. The 48 hour phenol LC50 was significantly higher for mosquitofish from Valley Creek, below the point where the creek receives coke-treatment wastewater from a steel plant, than for populations from Village Creek or the unpolluted Lake Purdy. The 8-hour tests confirmed the existence of resistant and susceptible phenotypes in the Valley Creek and Lake Purdy populations. Both populations contained fish of resistant and susceptible phenotypes. The difference was in their relative frequencies. In Valley Creek, 67-80% of the fish were resistant whereas in Lake Purdy, only 23-27% of the fish were resistant. An 8-hour toxicity test with 1 mg/liter potassium cyanide showed no discrete categories of susceptible or resistant fish. Mortality occurred throughout the test and a majority of fish died in the middle 4 hours. (Baker-IVI)
W84-03322

WATERBORNE DISEASE OUTBREAKS - 1946-1980: A THIRTY-FIVE-YEAR PERSPECTIVE,
Breidenbach Environmental Research Center, Cincinnati, OH.
E. C. Lippy, and S. C. Waltrip.
Journal American Water Works Association, p 60-67, February, 1984. 16 Fig, 5 Tab, 8 Ref.

Descriptors: *Human diseases, Disinfection, Water supply, Water quality control, Microorganisms, Public health, Pathogenesis.

The 672 outbreaks of waterborne disease that were reported in the United States between 1946 and 1980 affected more than 150,000 persons. An analysis of the data from these oubreaks provides information on how often and where they occurred, as well as on what caused them. Using just the data from 1976-1980, when reporting was greatly improved, the average annual frequency of outbreaks was 38. Clustering was evident when outbreaks in community systems were geographically distributed and rate-based according to the number of water systems in a respective state. Outbreaks exhibit temporal distribution, with peak occurrences in June, July, and August. Although outbreaks in noncommunity systems outnumber those in community systems, the frequency of outbreaks is almost twice as great in community systems. Cases of illness occurring in community water systems far outnumber those in noncommunity systems. Regulatory agencies should concentrate their efforts on protecting the source of water supply. Microbial agents that cause waterborne outbreaks are rarely isolated from the water system. The deficiences in water systems that caused and contributed to waterborne outbreaks during this 35 year period differed little from those reported for the previous 26 years. The glaring deficiencies were that disinfection was not in place where it was needed and not properly operated where it was in place. (Baker-IVI)
W84-03368

THE INFLUENCES OF TEMPERATURE VARIATIONS AND THERMAL POLLUTION ON VARIOUS ASPECTS OF THE BIOLOGY OF THE PRAWN PALAEMON PACIFICUS (STIMPSON),
Cape Town Univ. (South Africa). Dept. of Zoology.
Y. Achituv, and P. A. Cook.
Journal of Experimental Marine Biology and Ecology, Vol. 74, No. 3, p 291-302, January, 1984. 3 Fig, 8 Tab, 15 Ref.

Descriptors: *Temperature effects, *Thermal pollution, *Prawn, *Palaemon pacificus, *Stimpson, Thermal stress, Growth, Growth kinetics, Juvenile growth stage, Growth stages, Fish behavior.

The influence of different temperatures 10, 15, 20, and 25 degrees Centigrade on the food consumption, growth, moulting rate, and respiration of Palaemon pacificus (Stimpson) from Langebaan Lagoon, west coast of South Africa, under laboratory conditions, produced a high mortality rate at 10 degrees C. At higher temperatures, food consumption was found to be temperature dependent, the rate at 25 degrees C being twice that at 15 degrees C. Growth rate was most favorable at 25 degrees C. At 28 degrees C growth rate was lower than at 20 degrees C but higher than at 15 degrees C. The intermoult period was 17 days at 15 degrees C, and 11 and 10 days at 20, and 25 degrees C, respectively. There are several indices of growth efficiency at different temperatures. Its temperature preferences cause the appearance of this prawn in South African west coast localities such as Langebaan during the summer and its disappearance during winter. It is possible that thermal pollution from a nuclear power station may be beneficial to this prawn. (Murphy-IVI)
W84-03371

AQUATIC EFFECTS OF WET ASH DISPOSAL AND WET LIMESTONE SCRUBBER SYSTEMS,
Tennessee Valley Authority, Chattanooga.
R. J. Ruane, J. D. Milligan, R. C. Young, T.-Y. J. Chu, and H. Olem.

Water Science and Technology, Vol. 15, No. 11, p 149-153, 1983.

Descriptors: *Industrial wastes, *Wastewater treatment, Scrubbers, Limestone, Ash, Fly ash, Coal, Groundwater pollution, Leachate, Sludge disposal.

Research on the major areas of concern for aquatic impacts in wet ash disposal and wet limestone SO2 scrubbers is reviewed. Emphasis is placed on monitoring efforts on ash pond effluents, lab studies on coal ashes, effects of coal-ash leachate on ground water quality, investigations on scrubbers sludge, and toxicity of ash pond effluents. (Baker-IVI)
W84-03375

ACID RAIN, CATCHMENT CHARACTERISTICS AND FISHERY STATUS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
P. F. Chester.
Water Science and Technology, Vol. 15, No. 12, p 47-58, 1983. 8 Fig, 13 Ref.

Descriptors: *Acid rain, *Catchment areas, *Fisheries, Effective reactivity, Prediction, Oligotrophic lakes, Chemical properties.

Data on lake chemistry and fishery status in the Sorlandet area of South Norway are examined for relationships between acid inputs, water composition and fishery status. The effective catchment reactivity is a much better predictor of fishery status than is acid input to these catchments. An analysis of the only extensive published data set relating water chemistry to fishery status in oligotrophic acid lakes does not support the simple thesis that acid deposition has affected fishery status unless it is assumed that soil minerals or catchment characteristics have been altered substantially by acid deposition. To account for the reported changes in barrenness over the last 30-40 years, the effective reactivity or neutralizing capability of the most affected catchments will have to decrease by a factor of two. It is unlikely that this happened so rapidly through depletion or exhaustion of base cations. Observation of catchment reactivity as revealed by simple measurements of lake water chemistry over a period of a few years determine whether changes of the required magnitude are occurring in the catchments. A proper understanding of the reactivities and biological activity of the catchments and their evolution with time is crucial for the specification of effective measures to counter the decline in fisheries. (Murphy-IVI)
W84-03385

FISHERY STATUS AND WATER QUALITY IN AREAS AFFECTED BY ACID DEPOSITION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
G. D. Howells.
Water Science and Technology, Vol. 15, No. 12, p 67-80, 1983. 9 Fig, 3 Tab, 25 Ref.

Descriptors: *Fish populations, *Water quality, *Acidity, Oligotrophic lakes, Fish, Mortality, Hydrogen ion concentration.

A review of current information from both field and laboratory investigations concerning the responses of fish and fish populations to natural acid conditions in Scandinavian and North American lakes and rivers, identifies the factors which determine survival and mortality. It is generally recognized that fisheries do not thrive in acid waters below pH 5. Fifty-percent of lakes below pH 5 are fishless, compared with only one in seven of similar oligotrophic lakes with pH greater than 5. Both field and laboratory studies provide evidence that other water quality factors (such as the levels of aluminium and calcium), biological factors (such as food supply, genetically determined tolerance, adaptation), and ecological factors (such as lake morphology, patterns of hydrological events) are also important. (Murphy-IVI)
W84-03387

RELIABILITY OF RIVER-TREATMENT PLANT SYSTEMS,
Ohio State Univ., Columbus.
R. M. Sykes.
Journal of Environmental Engineering, Vol. 110, No. 1, p 166-173, February, 1984. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Water pollution sources, *Wastewater treatment, *Pollution load, *River flow, Drought, Low flow, Flow rate, Effluents, Water quality standards.

The reliability of river - treatment plant systems is determined by considering fluctuations in both the streamflow rate and waste loading rate. The method involves an application of the elementary theory of hydrologic statistics and waste assimilation models to the cumulative density functions of the flow rates and loading rates. The products of the method are the expected number of system failures per drought, the interval between failures and the annual return period of droughts containing at least one systems failure. It is shown that the usual methods based on rare drought flows, (e.g., the seven-day average flow with a 10-yr return period) cannot provide this information. Also, designs based on rare drought flows are not conformable to stream standards, whereas designs based on the proposed method are intrinsically conformable to stream standards. (Author's abstract)
W84-03474

THE INFLUENCE OF THE GRAND RIVER ON PHYTOPLANKTON NEAR THE NORTHEASTERN SHORE OF LAKE ERIE DURING 1979,
Ontario Ministry of the Environment, Rexdale. Limnology and Taxonomy Section.
K. H. Nicholls, R. Taylor, and Y. Hamdy.
Archiv fur Hydrobiologie, Vol. 98, No. 2, p 146-172, October, 1983. 21 Fig, 3 Tab, 22 Ref.

Descriptors: *Phytoplankton, *Grand River, *Lake Erie, *Ontario, *Water pollution effects, Biomass, Plant communities, Nutrients, Phosphorus, Eutrophication, Water quality.

The phytoplankton in the region of the Grand River and adjacent northeastern Lake Erie (Ontario, Canada) was investigated during April-November of 1979 to determine the influence of the river on the phytoplankton of the lake. Average phytoplankton biomass ranged from 0.45 cu mm/l in the lake to 7.6 cu mm/l in the river mouth. The phytoplankton communities of the two river mouth stations were most similar, but were related to those at the Lake Erie stations at much lower percentage similarities. Stations west of the Grand River were more similar to each other in phytoplankton community structure than to stations east of the Grand River. The influence of the Grand River on Lake Erie phytoplankton was greatest during spring. The distribution of two indicator species, Skeletonema potamos (Weber) Halse and Stephanodiscus hantzschii Grun., suggests that the major influence of the Grand River during the summer was confined to an area within only 5-10 km of the river mouth. The nutrient and phytoplankton data imply that further controls on phosphorus loading will achieve lower densities of algae and improved water clarity, especially in the river mouth area. (Author's abstract)
W84-03489

A COMPARATIVE SURVEY OF ANCYLUS FLUVIATILIS (MULLER) POPULATIONS IN THE AFON CRAFNANT, N. WALES, ABOVE AND BELOW AN INPUT OF ZINC FROM MINE-WASTE,
Liverpool Univ. (England). Dept. of Zoology.
M. Willis.
Archiv fur Hydrobiologie, Vol. 98, No. 2, p 198-214, October, 1983. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Acylus, *Snails, *Zinc, *Water pollution effects, *Afon Crafnant, *Wales, Mine wastes, Reproduction, Population dynamics, Heavy metals, Toxicity.

The growth, reproductive success and population dynamics of Ancylus fluviatilis (Muller) were studied in a stream receiving zinc from mine-waste at two sites, one upstream and one downstream of the input, over an 18 month period. Samples were collected monthly by clearing 25 quadrats of all Ancylus at each site. Shell dimensions were measured using a binocular microscope with calibrated eyepiece and dial calipers. Histological techniques were employed to determine sexual maturity. Reproductive success was measured by estimating the number of egg-capsules and number of eggs per capsule at each site. Wet ashing techniques followed by analysis using flame atomic adsorption spectrophotometry were used to determine the extent of bioaccumulated zinc. 'Total' zinc and several other metals in the waters were measured using flame atomic adsorption spectrophotometry. A small density of Ancylus was found at the site influenced by zinc. Spring-growth commenced approximately one month later at this site but a similar growth rate of the spats occurred during the summer months. Fewer eggs were found, egg-capsules were more likely to be empty and were smaller at the site influenced by zinc. More zinc was accumulated in the tissues of Ancylus at this site. (Author's abstract)
W84-03490

PROPERTIES OF ACID BROWN WATER STREAMS IN SOUTH SWEDEN,
Lund Univ. (Sweden). Dept. of Animal Ecology.
C. Otto, and B. S. Svensson.
Archiv fur Hydrobiologie, Vol. 99, No. 1, p 15-36, December, 1983. 8 Fig, 5 Tab, 56 Ref.

Descriptors: *Acid streams, *Sweden, *Biological properties, *Chemical properties, Hydrogen ion concentrations, Water pollution effects, Alkaline water, Light penetration, Aquatic fauna.

Whether direct or indirect, pH influences the composition of the fresh water fauna. Based on data from about 300 streams in southern Sweden, the lower pH levels at which common lotic invertebrates have been observed reveal that pH alone is not responsible for the documented impoverished fauna in acid/humic watersheds. A shredder, Potamophylax cingulatus, grew significantly larger in acid as compared to neutral and alkaline streams, despite evidence of physiological stress at low pH. An extended availability of leaf material was documented in the acid stream. A significant positive correlation between number of macroinvertebrate species and pH was established. Shredders and grazers were less abundant at low pH, whereas no significant correlation with pH was found for number of species of deposit feeders, filter feeders and predators. Relationships between pH, organic carbon, aluminum and light transmission were investigated from data obtained in 25 brown water streams. It is suggested that light penetration at the bottom might be a limiting factor for primary production in such streams during the summer. Accumulation of aluminum in P. cingulatus larvae was low despite high background levels. The observation indicates that transport of aluminum from humic waters to terrestrial food chains is not very high. (Murphy-IVI)
W84-03502

5D. Waste Treatment Processes

STUDIES ON STABILIZATION PONDS FOR DOMESTIC SEWAGE IN INDIA,
Government Post Graduate School, Sehore (India). Dept. of Botany.
A. V. Rao.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 3, p 411-434, 1983. 14 Fig, 15 Tab, 19 Ref.

Descriptors: *Stabilization ponds, *Domestic wastes, Biological oxygen demand, Chemical oxygen demand, Phosphates, Ntrogen, Bottom sediments, Chemical properties.

For one year a single cell stabilization pond, T. T. Nagar, Bhopal (August, 1968 to July, 1969) and series stabilization ponds, Shahpur, Bhopal (January, 1969 to December, 1969) were studied. Climatological conditions in Bhopal were favorable for

the treatment of sewage in stabilization ponds. There was a considerable reduction in BOD, total nitrogen, phosphate, coliforms and enterococci during the process of treatment. The reductions were highest in series ponds. Diurnal variations had the highest pH, dissolved oxygen, algal cell number and lowest alkalinity values occur around 4.00 p.m. Algal flora present in the single cell pond consisted of 31 species representing 27 genera. In the series ponds 33 species belonging to 30 genera and 37 species belonging to 33 genera were in the primary and secondary ponds, respectively. (Murphy-IVI)
W84-02957

SEDIMENTATION OF ZEOLITE TYPE A IN WATER AND WASTEWATER,
Lisbon Univ. (Portugal).
For primary bibliographic entry see Field 5F.
W84-02978

BIOTECHNOLOGY AND EFFLUENT TREATMENT,
A. D. Wheatley, C. I. Winstanley, and L. Cassell.
Effluent and Water Treatment Journal, Vol. 23, No. 8, p 307-316, August, 1983. 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Water reuse, Activated sludge process, Filtration, Bioscrubbing, Adsorption, Biogas, Rotating biological contactors, Biological wastewater treatment.

Existing effluent treatment is reviewed emphasising processes available for by-product recovery and discussing the future prospects for environmental biotechnology for further recovery of useful materials and the breakdown of recalcitrants. The most recent change in biological filtration has been the introduction of plastic media in 1970, extending the range of applications to include high concentration wastes typical of industrial effluents. Another innovation has been the rotating biological contactor (RBC) in which a honeycomb of plastic sheets are slowly rotated on a shaft through a tank containing the wastewater. Developments in the activated sludge processes include the use of pure oxygen in completely enclosed tanks in 1972. An innovative application to effluent treatment was the use of a deep air lift fermenter. Advancements are also considered in the areas of removal by adsorption, bioscrubbing, biogas, and the recovery of biomass. (Baker-IVI)
W84-02979

AERATED LAGOON SYSTEMS WITH IMPROVED PERFORMANCE,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
L. G. Rich.
Public Works, Vol. 114, No. 4, p 35-36, 1983. 2 Fig, 2 Tab.

Descriptors: *Aerated lagoons, *Wastewater treatment, Domestic wastes, Biochemical oxygen demand, Total suspended solids, Design criteria.

A dual-multicellular aerated lagoon system is described which offers a low-cost alternative to high-maintenance, mechanically complex secondary treatment systems, especially for the treatment of small domestic wastewater discharges. For domestic wastewaters such systems consist of a first cell in which sufficient aerator power (about 30 hp per million gallons of basin capacity) is applied to maintain all organic solids in suspension. It is followed by three cells, each of which is aerated at a power level (from 5 to 10 hp per million gallons of basin capacity) that permits the settleable fraction of the suspended solids in the effluent from the first cell to settle. Solids that settle form deposits in which the biodegradable materials decompose in a benthal environment, giving off methane gas. Removal of soluble biochemical oxygen demand is enhanced by the multicellular configuration of the system and the high concentration of bacterial biomass kept in suspension in the first cell. Low effluent suspended solids are achieved by the multicellular configuration and by limiting the hydraulic retention time. For domestic wastewaters treated in the southeast the retention time in the first cell should be no more than 1.5 days and that in each of the other cells should be no more than about 1.2 days. As the system is relatively small in size, nonbiodegradable solids which accumulate at the bottom of the second, third, and fourth cells should be removed annually. However, these solids should be highly stable and ready for land disposal. (Baker-FRC)
W84-02982

ANTICIPATE FUTURE REQUIREMENTS FOR WASTEWATER HANDLING SYSTEMS,
Bechtel Associates, Ann Arbor, NJ.
J. O. Thaler, and P. K. Sinha.
Power Engineering, Vol. 87, No. 2, p 52-55, 1983. 2 Tab.

Descriptors: *Wastewater treatment, *Regulations, *Legislation, Industrial wastes, Powerplants, Ash, Bottom ash, System design, Design criteria, Wastewater treatment facilities.

Wastewater handling is a subject of growing concern to operating power plants. Many National Pollutant Discharge Elimination System (NPDES) permits have expired, or are expiring, and there will be no definitive federal position on pollutant discharge until the effluent guidelines are finalized and promulgated. The EPA is currently active in reviewing the overall Clean Water Act and is drafting proposed revisions to be submitted soon to Congress. Limitations established up to this point are considered. The finalized first round regulations separated power plant discharges into six controlled waste categories: once through cooling water, recirculating cooling water system blowdown, ash transport water (fly ash and bottom ash), metal cleaning wastes and boiler blowdown, low-volume wastes (collective), and all categories. First round best practical control technology available limitations were aimed at controlling the discharge of free available chlorine, total suspended solids, oil/grease, pH, copper and iron. They also specified total elimination of discharges containing PCB compounds. First round NSPS (new source performance standards) limitations were similar but contained some limitations even more strict than best available technology limits. Management considerations must be given to total residual chlorine in once-through cooling water discharges, TRC in recirculating cooling water system blowdown, bottom ash transport systems, water based metal cleaning wastes, and coal pile precipitation runoff. (Baker-FRC)
W84-02984

THE INFLUENCE OF FLOW CONDITIONS ON THE REMOVAL OF HEAVY METALS IN THE PRIMARY SEDIMENTATION PROCESS,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. C. Rossin, R. M. Sterritt, and J. N. Lester.
Water, Air, and Soil Pollution, Vol. 19, No. 2, p 105-121, 1983. 2 Fig, 7 Tab, 31 Ref.

Descriptors: *Heavy metals, *Wastewater treatment, Chromium, Copper, Lead, Nickel, Zinc, Cadmium, Flow, Suspended solids.

A pilot scale primary sedimentation pilot plant, treating raw sewage was used to assess the efficiency of removal of cadmium, chromium, copper, nickel, lead, and zinc. Heavy metal removals were determined during conditions designed to simulate normal dry weather flow, three times dry weather flow and diurnal variations in flow. During the study, the flows of sewage to the works where the pilot plant was were also varied. The efficiency of sewage treatment processes in removing heavy metals depends on two main factors: namely their existence as settleable particulate forms in the sewage and the conversion of soluble and non-settleable forms within the process. The heavy metal removal efficiencies in the primary sedimentation pilot plant varied considerably not only in terms of the effects of hydraulic loading on the process, but also on different sampling occasions at the same hydraulic loading. These variations may have been due to the manner of heavy metal input to the process. It appeared that metal input was not a continuous process, since data indicated that the concentrations of Cd, Cu, Pb, and Zn could increase by a factor of 2 to 3, and then return to initial concentrations in periods as short as 12 hr. In spite of the variations in concentrations of heavy metals in the sewage, the variations in percentage removals of heavy metals were much less and those variations in removal which did occur did not appear to be related to the heavy metal concentration. Metal removal was adversely affected by increasing the flow by a factor of three and by operating the plant under variable flow conditions. Suspended solids removal was not affected by increasing the flow. (Baker-FRC)
W84-02991

INDUSTRIAL WASTE ELIMINATION - AN OPTIMAL SOLUTION,
Industrial Waste Elimination Research Center, Chicago, IL.
J. W. Patterson, and W. A. Cawley.
Industrial Wastes, Vol. 29, No. 2, p 10-13, March/April, 1983. 4 Tab.

Descriptors: *Industrial wastes, *Wastewater treatment, Industrial Wastes Elimination Research Center, Water pollution control, Metals, Management, Planning.

The historical and still current approach to industrial pollution control has been end-of-pipe treatment and discharge of the treated effluent. This end-of-pipe approach evolved to control conventional pollutants such as biochemical oxygen demand and suspended solids and, in most instances, remains valid for control of such pollutants. However today we are also concerned with the identification and control of a wide spectrum of toxicants, and innovative approaches and methodologies must be considered for treating them. The concept of pollution avoidance is gaining increasing acceptance as an alternative to conventional approaches to pollution control. It is an inherently attractive concept in that it addresses the opportunities to conserve valuable resources while avoiding the costs and environmental risks of ultimate waste dispersal. The Industrial Wastes Elimination Research Center (IWERC) has five research projects currently being coordinated and funded including projects focusing on metals recovery, sorption/desorption recovery for organics, liquid-liquid membrane extraction techniques for organics and metals and catalysts. Most of the funding currently comes through block grants from EPA. (Murphy-IVI)
W84-03040

THE ANAEROBIC APPROACH: A BETTER ANSWER,
Celanese Chemical Co., Bishop, TX.
L. M. Harvey, and J. C. Rubiano.
Industrial Wastes, Vol. 29, No. 2, p 22-25, March/April, 1983. 2 Fig, 2 Tab.

Descriptors: *Wastewater treatment, *Anaerobic conditions, Industrial wastes, Celanese Chemical Company, Bishop, Texas, Chemical wastes, Activated sludge process.

An anaerobic wastewater treatment process has been developed for high-strength industrial wastewaters. The system pretreats wastes in one location in order to reduce organic concentration for municipal discharge. At another location the same system, followed by aerobic polishing, provides organic COD reduction and odor abatement on chemical wastes prior to disposal in solar evaporation ponds. At the Celanese facility in Bishop, Texas a retrofit of the system to an existing activated sludge unit has expanded the plant's capacity and made possible the biodegradation of wastes which were previously classified as untreatable. The anaerobic system was expected to lower operating costs as a result of reduced aeration requirements of the aerobic system, net fuel value of the offgas produced in the anaerobic reactor, and reduced sludge production. The combined Celrobic anaerobic reactor and activated sludge system will provide for treatment of greater than 95% of the

plant's organic wastewaters through the 1980s. (Baker-IVI)
W84-03042

TRANSFERABLE DISCHARGE PERMITS AND ECONOMIC EFFICIENCY: THE FOX RIVER,
Colby Coll., Waterville, ME. Dept. of Economics.
W. O'Neill, M. David, C. Moore, and E. Joeres.
Journal of Environmental Economics and Management, Vol. 10, p 346-355, 1983. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Wastewater disposal, *Economic efficiency, *Permits, *Fox River, Wisconsin, Economic feasibility, Cost analysis, Economic evaluation, Systems analysis, Computer models, Mathematical models, Pollution load, Water pollution control.

Recent emphasis on reforms of environmental regulation has led to suggestions for strategies which maintain environmental standards but allow the needed flexibility and cost effectiveness. The transferable discharge permit (TDP) is one such strategy for water pollution control recently adopted in Wisconsin. There was substantial cost savings from trading TDPs from data on the Fox River in Wisconsin. A simulation model of water quality (Qual-III) and a linear programming model of abatement costs determine the optimum pattern of discharge. Reaching that optimum from proposed pollution abatement orders is feasible. Varying conditions of flow and temperature can be accommodated using trade coefficients which can be accurately estimated through interpolation. The calculations are valuable and feasible in conjunction with the flexible regulations governing water pollution abatement. There is no obstacle to trading permits even when the permit itself varies in proportion to the assimilative capacity of the river. (Murphy-IVI)
W84-03046

SUBSURFACE INJECTION OF TREATED SEWAGE INTO A SALINE-WATER AQUIFER AT ST. PETERSBURG, FLORIDA - AQUIFER PRESSURE BUILDUP,
Geological Survey, Tampa, FL.
J. J. Hickey.
Ground Water, Vol. 22, No. 1, p 48-55, January-February, 1984. 6 Fig, 10 Ref.

Descriptors: *Florida, *St. Petersburg, *Injection wells, *Underground waste disposal, *High pressure, *Aquifers, *Confined groundwater, Wastewater disposal, Chlorides, Groundwater movement, Municipal wastewater.

The city of St. Petersburg has been testing subsurface injection of treated sewage into the Floridan aquifer as a means of eliminating discharge of sewage to surface waters and as a means of storing treated sewage for future non-potable reuse. The injection zone originally contained native saline ground water that was similar in composition to sea water. The zone has a transmissivity of about 0.0000012 sq feet/day and is within the lower part of the Floridan aquifer. Treated sewage that had a mean chloride concentration of 170 (mg/l) was injected through a single well for 12 months at a mean rate of 0.000047 cubic feet/day. The volume of water injected during the year was 1.7 times 10 to the 8th power cubic feet. Pressure buildup at the end of one year ranged from less than 0.1 to as much as 2.4 pounds/sq inch in observation wells at the site. Pressure buildup in wells open to the upper part of the injection zone was related to buoyant lift acting on the mixed water in the injection zone in addition to subsurface injection through the injection well. Calculations of the vertical component of pore velocity in the semi-confining bed underlying the shallowest permeable zone of the Floridan aquifer indicate upward movement of native water. This is consistent with the 200 to 600 mg/l increase in chloride concentration observed in water from the shallowest permeable zone during the test. (Author's abstract)
W84-03078

MODELS FOR WATER REUSE AND WASTEWATER PLANNING,
California State Water Resources Control Board, Sacramento.
M. Schwartz, and L. W. Mays.
Journal of Environmental Engineering, Vol. 109, No. 5, p 1128-1147, October, 1983. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *Mathematical models, *Water reuse, *Wastewater management, *Optimum development plans, Management planning, Cost analysis, Water treatment facilities, Maintenance costs, Operating costs, Costs, San Antonio, Texas.

The concepts of both water conservation and reuse are important in obtaining the maximum utility of water resources. A planning model for the determination of optimal water reuse allocation and wastewater treatment alternatives minimizes the overall cost of water supply and wastewater treatment over a planning period. The planning model consists of two models, each based upon dynamic programming (DP). The first model is an allocation DP model, which is used for the optimal allocation of water to users for each treatment alternative considered. The second model is a treatment DP model, which performs the optimal selection of treatment alternatives over time. The allocation DP model is used to define the state space for the treatment DP model. Application of the planning model is made to San Antonio, Texas. (Murphy-IVI)
W84-03091

LAGOON EFFLUENT POLISHING WITH INTERMITTENT SAND FILTERS,
Carollo (John) Engineers, Phoenix, AZ.
J. S. Russell, E. J. Middlebrooks, R. F. Lewis, and E. F. Barth.
Journal of Environmental Engineering, Vol. 109, No. 6, p 1333-1353, December, 1983. 11 Tab, 9 Ref.

Descriptors: *Wastewater lagoons, *Effluent polishing, *Sand filters, *Intermittent filters, Municipal wastewaters, Water quality, Water quality standards, Secondary wastewater treatment, Cost analysis, Biochemical Oxygen demand.

Intermittent sand filters are economical and as simple to operate as wastewater lagoons. All but one of the three lagoon-intermittent sand filter systems treating municipal wastewaters monitored satisfied the 1972 federal secondary treatment discharge standards for BOD5, and that facility removed 84% of the BOD5 instead of the required 85% removal. The 30-day mean effluent BOD5 concentrations for all three systems ranged from 3-21 mg/L with a percentage removal range of 84%-98%. The 30-day mean effluent SS concentrations ranged from 8-21 mg/L. Eighty five percent removal of SS was not achieved during two of the nine sampling periods. At no time did the 30-day geometric mean effluent fecal coliform concentration of the three systems exceed 200 organisms/100 ml. Geometric mean fecal coliform concentrations of less than 200 organisms/100 ml were produced without disinfection. Only three of 260 effluent samples had a pH value that did not lie within the required range of 6.0 to 9.0. Total treatment costs for the three filters evaluated ranged from $0.04-$0.06 per cu m of filtrate. (Murphy-IVI)
W84-03096

TREATMENT PLANTS ENTER COMPUTER IMMERSION PHASE,
V. von Buchstab.
Water and Pollution Control, Vol. 121, No. 2, p 18-22, March/April, 1983.

Descriptors: *Water treatment facilities, *Computers, *Wastewater treatment, Management, Cost-benefit analysis, Energy, Financial aspects.

The most immediate benefits of entering the computer immersion phase has been reduced labor costs and reassignments leading to higher maintenance orientation in some plants. The common thread running through the interviews with management of wastewater treatment and water treatment facilities was that municipalities, like all other clients, need to know the cost/benefits of their expenditures. Manpower savings are the best documented incentives to automate. Other factors include energy savings. Control schemes are now scavenging the energy content of sewage off-gases, for such functions as heating the digestion processes to optimal temperatures, or the use of methane to drive small, auxillary motors. More importantly, load-shedding schemes mean reduced hydrodemand charges by thoughtful load staggering. (Murphy-IVI)
W84-03099

NEW WATER AND WASTEWATER SYSTEMS FOR ELLIOT LAKE,
S. Davey.
Water and Pollution Control, Vol. 121, No. 5, p 8-10, 17, 33, September/October, 1983. 5 Fig.

Descriptors: *Water treatment facilities, *Wastewater treatment facilities, Elliot Lake, Activated sludge process, Chlorination, Filtration, Fluoridation, Design criteria, Planning, Decision making.

In the past two years $24 million has been spent on new water and sewage systems for Elliot Lake. The existing water plant was to be replaced with a 29,100 cubic m/day water treatment plant incorporating filtration, fluoridation and chlorination, designed to supply a population of 28,000. The plant's source of water is Elliot Lake, situated deep in the granitic Canadian shield. In addition the Estern Lake Sewage Treatment Plant was commissioned in December 1981 after only 11 months of construction. This plant uses a conventional activated sludge process to provide secondary treatment of a nominal design flow of 16,000 cubic m/day and a peak of 36,000 cubic m/day. Both systems are owned and operated by the town. (Baker-IVI)
W84-03100

OCCURRENCE OF LOW- AND HIGH-CHLORINATED PHENOLS IN MUNICIPAL SEWAGE BEFORE AND AFTER PASSING THROUGH BIOLOGICAL TREATMENT PLANTS,
Vandkvalitetsinstitutet, Hoersholm (Denmark).
J. Folke, and U. Lund.
Journal of Chromatography, Vol. 279, p 189-198, 1983. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Wastewater analysis, *Chlorinated phenols, *Biological wastewater treatment, Gas chromatography, Mass spectrometry, Phenols, Denmark.

Four Danish biological treatment plants for municipal sewage (located in the center of Copenhagen, in the Greater Copenhagen area, in a provincial town in Jutland with 56,000 inhabitants, and in a provincial town on Sealand with 29,000 inhabitants) were examined for their chlorophenol content and their ability to degrade these compounds. None of these plants was known to be charged with industrial wastewater containing chlorophenols. A routine method for the analysis of both low- and high-chlorinated phenols was developed, based on gas chromatography with electron-capture detection (GC-ECD). The method was evaluated by comparing the GC-ECD results with those obtained by combined gas chromatography-mass spectrometry with selected-ion monitoring, GC-MS(SIM), of the molecular ions of the specific phenols. The sensitivity of the GC-ECD method for the individual phenols increases with increasing number of chloro substituents The GC MS(SIM) method is better for the determination of low- and non-chlorinated phenols. The GC-ECD method has a greater sensitivity for the higher chlorinated phenols. The advantage that the GC-MS(SIM) method is free from errors caused by interfering compounds must be weighed against the advantages of the GC-ECD method, which is less costly with regard to instruments and more easily adapted to routine analyses. The total phenol content, determined by GC-ECD showed a good correlation with the phenol number, obtained by using the 4-aminoantipyrine method. (Moore-IVI)
W84-03159

SEPARATION OF BACTERIA FROM A METHANOGENIC WASTEWATER POPULATION BY UTILIZING A SELF-GENERATING PERCOLL GRADIENT,
Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik.
P. Scherer.
Journal of Applied Bacteriology, Vol. 55, No. 3, p 481-486, December, 1983. 1 Fig, 13 Ref.

Descriptors: *Bacterial analysis, *Density gradient separation, *Wastewater analysis, *Methane bacteria, Wastewater treatment, Sulfur bacteria, Methanosarcina, Methanothrix, Desulfovibrio.

Percoll consists of polyvinylpyrrolidone coated colloidal silica-gel particles which form a distribution of nearly spherical particles with a mean diameter of 17-30 nm. Bacteria from a methanogenic wastewater population could be separated with a self-generating density gradient of Percoll. The separation was performed by centrifugation for 30 min at 30000 g in a simple angle-head rotor. Three types of bacteria were concentrated to apparent homogeneity in different bands: these were attributed to the methanogens Methanosarcina and Methanothrix, and to the dissimilatory sulfate-reducing bacterium Desulfovibrio. By the addition of colored marker beads with a known density, the buoyant density of fractions can be estimated in the same centrifugation. This method should facilitate bacterial analysis of wastewater and should contribute to the understanding of the bacteria concerned with wastewater treatment. (Moore-IVI)
W84-03164

SLUDGE TREATMENT BY OXYOZOSYNTHESIS STOPS OCEAN DUMPING,
S. A. Peterson, and E. Mozell.
Public Works, Vol. 15, No. 1, p 42-43, January, 1984. 1 Fig, 1 Tab.

Descriptors: *Sludge treatment, *Oxyozosynthesis, *Sludge disposal, Sludge cake, Ozone, Oxygen, Cost analysis, West New York, New Jersey.

West New York's (New Jersey) sewage is treated by primary clarifyers. The sludge is moved into a 3,000-gallon pressurized reactor vessel where oxyozosynthesis treatment takes place. The atmosphere within the reactor consists of a 2:1 ratio of oxygen to ozone at a pressure of 60 psi. The source of ozone is a generator that converts oxygen gas to ozone. The total pressurizing and processing time per batch is 90 minutes. The process converts the sewage sludge into CROAL, an odorless, almost completely sterile cake. The CROAL, which more than meets federal and New Jersey standards for land application, is trucked to a nearby landfill. Before adopting the oxyozosynthesis process, the town disposed of sludge by ocean dumping, at an annual cost of $170,000; total annual cost for treatment by the oxyozosynthesis process is only $110,000. (Murphy-IVI)
W84-03190

GROWTH OF SALVINIA MOLESTA AS AFFECTED BY WATER TEMPERATURE AND NUTRITION; II. EFFECTS OF PHOSPHORUS LEVEL,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.
For primary bibliographic entry see Field 5C.
W84-03192

EFFECTS OF WASTEWATER IRRIGATION AND PLANT AND ROW SPACING ON SOYBEAN YIELD AND DEVELOPMENT,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
For primary bibliographic entry see Field 3C.
W84-03271

DECHLORINATION OF WASTEWATER AND COOLING WATER,
Maryland Univ., College Park. Dept. of Chemistry.
G. R. Helz, and L. Kosak-Channing.
Environmental Science and Technology, Vol. 18, No. 2, p 48A-55A, February, 1984. 87 Ref.

Descriptors: *Dechlorination, *Wastewater treatment, *Cooling water, Environmental effects, Effluents, Reviews, Sulfur dioxide.

A growing movement is under way in the United States to install dechlorination facilities, particularly at sewage treatment plants, to alleviate damage to downstream ecosystems. A thorough review determined that research is needed in treatment technology, downstream chemical effects and downstream biological effects of dechlorination. In treatment technology better SO2 application and control systems are needed. For downstream chemical effects, the effect of S(IV) compounds on trace metal geochemistry is important, particularly whether S(IV) compounds cause reductive dissolution of the Fe and Mn oxyhydroxides in a river's suspended load. To determine the effectiveness of dechlorination long-term and sublethal effects, such as effects on reproduction and avoidance behavior, are also necessary. (Murphy-IVI)
W84-03325

TECHNICAL NOTE: ADSORPTION OF P-DICHLOROBENZENE FROM WATER,
M. Pirbazari, and W. J. Weber, Jr.
Journal American Water Works Association, p 82-84, February, 1984. 4 Fig, 9 Ref.

Descriptors: *Adsorption, *Dichlorobenzene, Granular activated carbon, Humic acids, Water treatment.

The results of granular activated carbon adsorption studies for para-dichlorobenzene from water in the presence of a major class of naturally occurring compounds - humic acids, is presented. With a load of PDB as high as 185 micrograms/liter an empty bed contact time of only 0.17 min, and a hydraulic loading of 2.6 mm/sec, approximately 78,800 bed volumes of water were treated before an effluent breakthrough level of 1 microgram/liter was reached. The effectiveness of activated carbon for PDB removal appears not to be adversely affected by background organics such as humic acids. PDB adsorption by carbon appears readily reversible, suggesting that uptake from solution occurs primarily because of relatively weak van der Walls' attraction forces. The MADAM model was generally able to simulate and predict the performance of fixed-bed adsorbers for removal of PDB. (Baker-IVI)
W84-03370

TREATMENT OF ALKALINE WASTEWATER FROM LIGNITE-FIRED POWER PLANTS,
Wroclaw Technical Univ. (Poland). Inst. of Environment Protection Engineering.
A. M. Dziubek, and A. L. Kowal.
Water Science and Technology, Vol. 15, No. 11, p 155-162, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Alkaline water, Powerplants, Lignite, Aeration, Chemical composition, Calcium carbonate, Carbonates.

Alkaline wastewaters produced in the hydrotransport of some lignite ashes from the powerplant to the storage site have a high acidity and a high total hardness, so they cannot be discharged into a natural water course without treatment. Recommended are the attenuation of the alkalies contained in them, and precipitation of calcium carbonate. These experiments have substantiated the efficiency of recarbonation and aeration, two treatment procedures which may be of importance from the environmental viewpoint in that they employ no additional chemicals. As a result of aeration pH was decreased to a level of about 7.8, and alkalinity to a level of 30 to 50 g calcium carbonate/cu m, irrespective of the initial alkalinity value. The minimum time of aeration required to achieve the highest degree of precipitation varied from 4 to 8 hr, depending on the initial alkalinity level. Expended times of aeration required in the recarbonation process can be shortened by employing primary recarbonation with pure carbon dioxide or flue gases unitl a pH of 9.5 is reached. The further decrease of pH can be achieved by aeration. An additional advantage of this method is that the flocculation conditions for the precipitated calcium carbonate are evidently improved and the time needed for sedimentation is shortened following the recarbonation process. (Baker-IVI)
W84-03376

LANDFILL LEACHATE TREATMENT,
Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
J. D. Keenan, R. L. Steiner, and A. A. Fungaroli.
Journal of the Water Pollution Control Federation, Vol. 56, No. 1, p 27-33, January 1984. 1 Fig, 9 Tab, 7 Ref. EPA grant S-803926.

Descriptors: *Leachates, *Landfills, *Wastewater treatment, Municipal wastewater, Industrial wastes, Heavy metals, Copper, Iron, Mercury, Zinc, Nickel, Lead, Sedimentation, Ammonia stripping, Neutralization, Activated sludge processes.

Landfill leachate is often a high-strength wastewater characterized by extremes of pH, biochemical oxygen demand, chemical oxygen demand, and heavy metals. In addition, it is a wastewater which is variable from landfill to landfill, and over time and space at a particular landfill. Consequently, neither biological waste treatment nor chemical-physical treatment separtely achieves high removal efficiency. The leachate treatment facility used in this study is located at a landfill in Falls Township, Bucks County, Pa. The plant is designed to provide maximum operational flexibility to permit full-scale testing of a variety of treatment sequences. The sanitary landfill has a surface area of 50 acres, receives about 800 tons of refuse per day, 85% of which is municipal. The balance is industrial sludges and solid waste. The leachate is characterized by high concentrations of organic compounds which vary significantly day-to-day. Activated sludge treatment of the effluent from the chemical/physical units was extremely successful. The reduction in ammonia-N afforded by the ammonia stripping lagoon provided conditions suitable for the growth of activated sludge microorganisms. Overall the treatment sequence of lime precipitation, sedimentation, ammonia stripping, and neutralization followed by activated sludge produced an excellent final effluent with the following characteristics: organic matter reduced to 153 mg BOD-5/l, a 99% reduction; an effluent ammonia concentration of 75 mg/l which represented a 90% removal; and heavy metal concentrations of 0.07 mg chromium/l, 0.11 mg copper/liter, 2.7 mg iron/l, 0.12 mg lead/l, 0.004 mg mercury/l, 0.75 mg nickel/l and 0.53 mg zinc/l. (Baker-IVI)
W84-03427

RENOVATION OF WASTEWATER AT THE 23RD AVENUE RAPID INFILTRATION PROJECT,
H. Bouwer, and R. C. Rice.
Journal of the Water Pollution Control Federation, Vol. 56, No. 1, p 76-82, January, 1984. 2 Fig, 5 Tab, 16 Ref. EPA project S-802435.

Descriptors: *Wastewater treatment, *Infiltration, Water reuse, Activated sludge treatment, Soil-aquifer treatment, Ammonia, Phosphates, Coliforms, Irrigation, Recreation demand.

In arid areas, wastewater is an important resource that can be used for irrigation, recreational lakes, power plant cooling, and even for municipal purposes with adequate treatment. Where hydrogeologic conditions and land availability are favorable for groundwater recharge with infiltration basins, considerable quality improvement of the wastewater can be obtained by soil-aquifer treatment (SAT). An oxidation pond of 16 ha below the Phoenix 23rd Avenue Sewage Treatment Plant was split into four parallel infiltration basins to study large-scale renovation of secondary effluent by soil-aquifer treatment obtained by groundwater recharge using rapid infilration basins. The resulting renovated water can be pumped from the aquifer for unrestricted irrigation and recreational

lakes. Where the wastewater is to be recycled for drinking, soil-aquifer filtration provides an effective pretreatment of the water for activated carbon treatment, reverse osmosis, and disinfection. (Murphy-IVI)
W84-03428

SOIL-AQUIFER TREATMENT USING PRIMARY EFFLUENT,
R. C. Rice, and H. Bouwer.
Journal of the Water Pollution Control Federation, Vol. 56, No. 1, p 84-88, January, 1984. 6 Fig, 4 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Municipal wastes, Soil aquifer treatment, Suspended solids, Soil properties, Infiltration, Permeability coefficient.

Soil aquifer treatment of primary effluent is able to produce renovated water of equal or better quality than that obtained when using secondary effluent. The soil system can handle the higher organic carbon load of the primary effluent and provide adequate removal of bacteria and viruses. The infiltration capacity of the system depends on the hydraulic conductivity of the soil and the concentration and composition of the suspended solids. When the suspended solids are largely organic, most of the solids will accumulate on the soil surface where they are rapidly decomposed. Infiltration rates are restored after drying or by scarifying the surface by raking or harrowing. When the effluent contains fine inorganic solids, in-depth clogging may occur. The fine particles migrate downward and do not decompose, so that annual deep cultivation is needed to break up the clogged zone. A hydraulic loading capacity of 27 to 51 m/yr was obtained with an inundation schedule of 1 week wet and 1 week dry in the winter. This hydraulic loading represented 5 to 8% of the infiltration capacity of the soil or about 50% of the infiltration capacity expected for secondary effluent. Using primary effluent bypasses the expensive and energy-consuming secondary treatment process and provides renovated water at a lower cost, provided that land prices are not prohibitively high. (Baker-IVI)
W84-03429

FLOCCULENT SETTLING IN QUIESCENT SYSTEMS,
Geraghty and Miller, Inc., Baton Rouge, LA.
T. Y. R. Lo, and W. J. Weber, Jr.
Journal of Environmental Engineering, Vol. 110, No. 1, February, 1984. 12 Fig, 2 Tab, 16 Ref.

Descriptors: *Sedimentation, *Flocculent settling, *Settling rates, Suspended solids, Wastewater treatment, Settling velocity, Wastewater, Mathematical equations.

Characterization of the setting properties of suspensions for purposes of settling basin design and for prediction of suspended solids behavior in natural water systems is traditionally based on observations of settling rates of dilute suspensions in quiescent columns. Most suspensions of practical interest for water and waste treatment systems and natural aquatic environments are flocculent in character, and their settling cannot be described accurately in terms of minimum settling velocities. An empirical equation for description of the distribution of flocculent solids in quiescent settling columns was developed. The equation is predicated on observations made in the course of concentration-depth-time analyses of settling data for flocculent and nonflocculent solids in quiescent and agitated settling columns. The validity of the equation is verified by its application to ten different quiescent flocculent settling studies involving several sewages and natural lake and river suspensions. Application of the equation involves evaluation of two parameters: the flocculation coefficient and the discrete-equivalent velocity distribution. (Moore-IVI)
W84-03475

CHEMICAL OPTIMIZATION OF TERTIARY CONTACT FILTERS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. A. Boller.
Journal of Environmental Engineering, Vol. 110, No. 1, p 263-276, February, 1984. 12 Fig, 4 Tab, 18 Ref.

Descriptors: *Contact filters, *Precipitation, *Phosphorus removal, Wastewater treatment, Iron, Filtration, Polymers.

Pre- or simultaneous precipitation combined with contact filtration for final treatment is an excellent method to achieve low phosphorus residuals in waste-water discharges to lakes. The two dosing steps are optimized to allow for log chemical use and sufficiently long filter runs. If an Fe/P dissolved-ratio of about 2.0 is used in the first step, the Fe(III)-dosage to the second step may be kept below 4 g Fe(III)/cu m. This allows the precipitates together with the solids from the secondary clarifier to be removed in multi-media filters. The unfavorable filtering characteristics of the precipitates may be improved by dosing filter aids. In laboratory scale experiments low concentrations of nonionic polyacrylic polymers with high molecular weight showed best filter performance. Under optimized conditions with respect to precipitant and filter aid dosage, a full-scale treatment plant was investigated. Consistent low phosphorus residuals at 0.1-0.2 g P/cu m was reached at mean filtration rates of 7.4 m/h and average filter runs of 20 hr. (Author's abstract)
W84-03479

5E. Ultimate Disposal Of Wastes

APPRAISING WASTEWATER DISCHARGE COMPLIANCE LEVELS,
Allied Chemical Corp., Morristown, NJ. Corporate Research Center.
For primary bibliographic entry see Field 6B.
W84-03047

EFFECTS OF INDUSTRIAL BOILER BLOWDOWN DISCHARGES ON STREAMS,
Tennessee Dept. of Public Health, Nashville.
For primary bibliographic entry see Field 5C.
W84-03051

SLUDGE TREATMENT BY OXYOZOSYNTHESIS STOPS OCEAN DUMPING,
For primary bibliographic entry see Field 5D.
W84-03190

THE HANDLING AND DISPOSAL OF COAL ASH IN THE CEGB IN RELATION TO THE AQUEOUS ENVIRONMENT,
Central Electricity Generating Board, Manchester (England). Scientific Services Dept.
J. Brown, and N. J. Ray.
Water Science and Technology, Vol. 15, No. 11, p 11-24, 1983. 1 Fig, 7 Tab, 4 Ref.

Descriptors: *Handling, *Disposal, *Coal ash, *Central Electric Generating Board, *Aquatic environment, Percolation, Coal effluents, Groundwater, Aquifer characteristics, Slurries, Suspended solids.

Pulverised fuel ash (pfa) and furnance bottom ash (fba) are the Principal solid wastes from modern coal fired plants. These residues are often handled and disposed of as slurries and pfa is frequently used for the reclamation of derelict land. One factor which requires careful management is the level of suspended solids in the outfall when a lagoon is nearly full. Whether ash is disposed of wet, or merely conditioned with water to facilitate handling, there may be a further need to consider the percolation of water through the ash and its possible interaction with groundwater. This calls for knowledge or study of the ash itself, the size of the area to be reclaimed, the rainfall pattern and the local hydrogeology, including the size and rate of recharge of the aquifer. The basic Central Electricity Generating Board requires the combination of laboratory studies of percolate quality with hydrogeological assessment to evaluate the potential risks, if any. The actual consent to dispose of ash taking such factors into account, is made by the Local Authority in consultation with the Water Authority. The present view of ash disposal relative to the aqueous environment could be disturbed if legislation and the associated Codes of Practice were to become more stringent. (Murphy-IVI)
W84-03373

STUDIES ON THE LEACHING AND WEATHERING PROCESSES OF COAL ASHES,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Inorganic Chemistry.
H. Liem, M. Sandstrom, T. Wallin, A. Carne, and U. Rydevik.
Water Science and Technology, Vol. 15, No. 11, p 163-191, 1983. 15 Fig, 7 Tab, 6 Ref.

Descriptors: *Leaching, *Weathering, *Coal, *Ashes, Computer programs, HALTAFALL, Metals, Hydrogren ion concentration, Mass-action law, Crystallization.

The Swedish project Coal-Health-Environment studies leaching on several types of coal ashes, fly ashes, bottom ashes and scrubber sludges to determine the effects of pH, pCl, pCO3, pEDTA and pSO4 in the leaching solution on the leaching of metals from coal ashes. The leaching of Cr, Co, Ni, Cu, Zn, Mo, Se, As, Cd, and Pb increases with pH for pH less than 2 and pH greater than 9, and decreases for pH greater than 2 but less than 6. The metal leaching behavior may in part be explained by the mass-action law. Through X-ray diffraction techniques the dominating crystalline phases in the different coal ashes were mullite (3Al2 times 2SiO2), alpha-quartz (Si02) and the iron oxides magnetite and hematite. Equilibrium analysis on various metals and compounds were made partly using the computer program HALTAFALL. (Murphy-IVI)
W84-03377

USE OF 'THE CAPILLARY BARRIER' AS A SHIELD AGAINST GROUNDWATER POLLUTION FROM FLY-ASH DEPOSITS,
Danmarks Geologiske Undersoegelse, Copenhagen. Hydrogeological Div.
L. J. Andersen, and B. Madsen.
Water Science and Technology, Vol. 15, No. 11, p 207-212, 1983. 4 Fig, 4 Ref.

Descriptors: *Capillary barrier, *Groundwater Pollution, *Fly ash, Capillarity, Membranes, Permeability, Semipermeable membranes, Leaching, Waste storage.

The enormous amounts of fly ash produced by the burning of coal in power plants have resulted in a number of environmental problems, not least of which is the increased risk of groundwater pollution from its deposition in gravel pits. In order to prevent this pollution, fly ash deposits have often been established with an underlying membrane. Such membrane-systems are quite expensive to build and necessitate a continuous pumping and removal of percolate. The alternative of covering the fly ash with a low-permeable membrane, which removes the infiltrated water laterally, prevents not only groundwater pollution but also the formation of percolate. By using the principle of 'The Capillary Barrier,' the low-permeable membrane can be constructed of natural and resistant porous materials. (Murphy-IVI)
W84-03378

PREVENTION OF WATER POLLUTION BY THE USE OF FLY-ASH AS A SUBSTITUTE FOR EXTRACTED RAW MATERIALS,
Miljoeministeriet, Copenhagen (Denmark).
J. Lyngvig.
Water Science and Technology, Vol. 15., No. 11, p 213-222, 1983. 3 Fig, 3 Tab.

Descriptors: *Waste disposal, *Waste recovery, Industrial wastes, Powerplants, Fly ash, Building materials, Clay, Gravel.

One of the major problems in disposing of big quantities of fly-ash is the possible washing out of heavy metals which may pollute subsoil water. The washing out of chlorides and sulfates is also of concern. The use of fly-ash as a substitution material for gravel and clay has to be regarded as a way of disposing of a waste product as well as a way of saving the limited resources of natural raw materials and also as a technical and economical innovation in the building and construction industries. A brief history of the Raw Materials Act is offered along with a listing of possible applications of waste products, documentation for the use of fly-ash as a substitution material and possibilities for the future. (Baker-IVI)
W84-03379

MODEL OF ION EQUILIBRIUM IN AQUEOUS SOLUTIONS OF FLY ASH IN THE CONTEXT OF PREDICTION OF GROUND AND SURFACE WATER CONTAMINATION,
Instytut Ksztaltowania Srodowiska, Katowice (Poland). Environmental Pollution Abatement Centre.
For primary bibliographic entry see Field 5B.
W84-03381

5F. Water Treatment and Quality Alteration

SEDIMENTATION OF ZEOLITE TYPE A IN WATER AND WASTEWATER,
Lisbon Univ. (Portugal).
M. J. T. Carrondo, J. N. Lester, and R. Perry.
Effluent and Water Treatment Journal, Vol. 23, No. 7, p 271, 273-280, July, 1983. 11 Fig, 5 Tab, 29 Ref.

Descriptors: *Detergents, *Water treatment, *Wastewater treatment, Water pollution sources, Phosphorous, Zeolite type A, Aluminosilicates, Sedimentation.

Zeolite type A is a synthetic aluminosilicate which may be used to partly replace phosphorus compounds as detergent builders. The settling behavior of zeolite type A in water and wastewater was investigated. The use of Stokes' law in conjunction with the particle size distribution yields reasonably accurate predictions for the removal of zeolite type A when compared with the results of settling column tests, although the particles are not spherical. The removals computed from the integration of settling curves obtained from column tests compare well with the model tank tests, although the tank removals are marginally lower. Even at low overflow rates, removal of zeolite type A in water was low. As anticipated, zeolite type A in concentrations of about 30 mg/liter was removed at a faster rate from sewage than would be predicted by Stokes' law. When zeolite type A was present in raw sewage at about 30 mg/liter the percentage of suspended solids removed in static column tests was marginally reduced from the values obtained in raw sewage when zeolite was absent. Under flocculant settling conditions in raw sewage zeolite type A was removed to a lesser extent than the other suspended solids, particularly during the initial stages of the settling tests. This might imply lower zeolite type A removals in hydraulically overloaded tanks compared to suspended solids removal. (Baker-IVI)
W84-02978

LEAD IN DRINKING WATER-INVESTIGATION OF A CORROSIVE WATER SUPPLY,
Morris Township Health Dept., Convent Station, NJ.
J. A. Benson, and H. Klein.
Journal of Environmental Health, Vol. 45, No. 4, p 179-181, 1983. 1 Tab, 23 Ref.

Descriptors: *Drinking water, *Lead, *Corrosion, Public health, Water quality, Potable water, Reservoirs, Pollutant identification, Hydrogen ion concentration.

A corrosive water supply in Morris County, New Jersey was investigated and appeared to result from leaching lead out of solder in household plumbing systems. From June through November, 135 water samples were taken from 99 locations in the reservoir service area and analyzed. First flush samples were taken the first thing in the morning, representing water that had been standing in the plumbing overnight. Standing grab samples were taken during the day without allowing the water to run first. Running grab samples were taken, and also composite samples, which were samples taken immediately before use of the water for drinking or cooking. Of the first flush samples 32% showed lead levels in excess of 0.05 mg/l. Children living in these homes had on the average 14 micrograms/dl blood lead. In order to correct the problem the water authority sent notices out to customers to flush their plumbing systems out in the morning prior to use. In addition the pH of the water was raised from about 6.1 to 7.9 by lime addition. The water authority also began replacing the reservoir water with well water purchased from another nearby water authority. (Baker-FRC)
W84-02983

RETROSPECTIVE ANALYSIS OF THE RESPONSE OF SAGINAW BAY, LAKE HURON, TO REDUCTIONS IN PHOSPHORUS LOADINGS,
Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5C.
W84-03033

NEW WATER AND WASTEWATER SYSTEMS FOR ELLIOT LAKE,
For primary bibliographic entry see Field 5D.
W84-03100

CHLORINATION-FILTRATION FOR IRON AND MANGANESE REMOVAL,
Raymond Kaiser Engineers, Inc., Oakland, CA.
J. M. Wong.
Journal of the American Water Works Association, Vol. 76, No. 1, p 76-79, January, 1984. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Chlorination, *Filtration, *Iron, *Manganese, Groundwater, Water treatment, Suspended solids, Cost analysis, Pilot plants.

Processes in which oxidation is followed by removal of suspended solids can effectively remove soluble iron and manganese from water. The common processes for removing iron and manganese are aeration-filtration, chlorination-filtration, and potassium permanganate-manganese greensand filtration. The potassium permanganate-manganese greensand filtration has an advantage in that the greensand can act as a buffer. The major disadvantages of the aeration-filtration process are that the initial costs are high and if the soluble manganese concentration is greater than 1 mg/L, additional retention time and supplemental chemical treatment may be required. Chlorination-filtration is often slow and incomplete. At pH 8.4 and above the chlorination-filtration process effectively removes iron and manganese. The costs for oxidants in chlorination-filtration are less than those for potassium permanganate-manganese greensand filtration. (Murphy-IVI)
W84-03142

OVERLAND FLOW FOR IRON REMOVAL FROM POTABLE WATER,
Clemson Univ., SC. Dept. of Agricultural Engineering.
J. Zirschky, and L. Carlson.
Journal of the American Water Works Association, Vol. 76, No. 1, p 80-83, January, 1984. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Overland flow, *Iron removal, *Potable water, Water treatment, Groundwater, Heavy metals, Iron, Water reclamation, Chemical degradation.

Overland flow, an effective wastewater treatment process, can be used for potable water treatment. Many groundwaters contain excessive amounts of ferrous iron that result in a water of poor aesthetic quality. The natural reaeration that occurs during overland flow oxidizes ferrous iron to the more insoluble ferric form. The resulting precipitate then settles on the slope. An existing overland flow treatment system in Salo, Finland, achieves 97% iron and manganese removal. The system has a capacity of 1ML/d. Iron-bearing groundwater is discharged at the top of a 100-m long, 17-degree, natural slope. At the bottom of the slope, the water infiltrates into sand and gravel recharge basins where any remaining iron precipitate is filtered from the runoff. There are few mechanical systems to require maintenance, supervision or energy. Removal of the precipitate from the surface of the recharge basins is required only once a year. (Murphy-IVI)
W84-03143

THE OCCURRENCE OF ALUMINUM IN DRINKING WATER,
R. G. Miller, F. C. Kopfler, K. C. Kelty, J. A. Stober, and N. S. Ulmer.
Journal of the American Water Works Association, Vol. 76, No. 1, p 84-91, January, 1984. 6 Fig, 13 Tab, 16 Ref.

Descriptors: *Aluminum, *Drinking water, Potable water, Groundwater, Surface water, Water quality, Raw water, Municipal water, Coagulation, Iron, Alum.

Raw and finished water samples were collected from 186 water utilities five times throughout a year and analyzed for iron and aluminum content. The water samples were categorized by the supply source (ground, surface, or a combination of both), the type of water (raw, finished, or untreated distribution samples), and the type of coagulation used in the treatment process (aluminum sulfate, ferric chloride, other coagulants such as cationic polymers, or no coagulant). The samples were also categorized according to the 10 EPA regions and 4 population categories. In the few facilities that used iron as a coagulant, the concentrations of iron and aluminum decreased. When alum is used for coagulation, there is a 40-50% chance that the concentration of aluminum will increase above the original concentration in raw water. Aluminum is also more likely to exist in surface waters than in groundwaters. (Murphy-IVI)
W84-03144

CONTROL OF TRIHALOMETHANE PRECURSORS IN DRINKING WATER: GRANULAR ACTIVATED CARBON WITH AND WITHOUT PREOZONATION,
Louisiana Tech Univ., Ruston.
W. H. Glaze, and J. L. Wallace.
Journal American Water Works Association, p 68-75, February 1984. 15 Fig, 4 Tab, 20 Ref.

Descriptors: *Drinking water, *Trihalomethanes, Preozonation, Ozonation, Granular activated carbon, Water quality control, Water treatment.

In a pilot study that lasted 80 weeks, unozonated and ozonated waters were fed to granular activated carbon columns to compare the removal of trihalomethane formation potential by GAC treatment with that by ozone-GAC treatment. The results were comparable for these treatments. Preozonation before GAC adsorption did not have a dramatic effect on the removal of THM precursors, at least at the dosages used in this study, generally 2-3.5 mg/liter. The GAC columns outperformed the ozone-GAC systems in terms of cumulative TOC or THMFP removed. In terms of percentage removal, however, the two trains performed almost identically. Natural organics were slightly less adsorbable and slightly more biodegradable after ozonation, making the ozone-GAC systems and GAC systems perform nearly the same. Optimization of the ozone dosage and the GAC reactivation regime should lead to enhanced microbiologic removal, which would extend the lifetime of GAC for THMFP removal. (Baker-IVI)
W84-03369

RELATIONSHIP OF NITRATE CONCENTRATIONS TO DISTANCE OF WELL SCREEN OPENINGS BELOW CASING WATER LEVELS,
Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Water Resources Bulletin, Vol. 19, No. 6, p 977-981, December, 1983. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Nitrates, *Well water, *Kansas, Well screens, Depth, Groundwater pollution, Unconsolidated aquifers.

Data from 54 wells in central and eastern Kansas developed in unconsolidated deposits of Quaternary age indicate that nitrate concentrations are inversely related to the depth of the well screen opening below the water level in the well casing. Because this relationship was found to exist in an area of Nebraska and in a large area of Kansas, the relationship is generally valid over a wide geographical area. In addition, the data indicate that the incidence of nitrate concentrations exceeding 45 mg/l and nitrate concentrations, in general, are significantly lower in water from wells with screens deeper than 25 ft below the water table in unconfined aquifers or where screens are placed in deep confined aquifers. No concentrations of nitrate greater than 45 mg/l were in observed wells where screens were deeper than 60 ft below the casing water level. Placement of well screens as far below the water table as possible in unconfined unconsolidated aquifers in Kansas, and possibly other areas of the Midwest, may be an effective measure in preventing undesirable nitrate concentrations in ground water supplies, particularly in areas where nitrate is a problem. (Author's abstract)
W84-03403

5G. Water Quality Control

TROUT-ZOOPLANKTON RELATIONSHIPS IN MEDICAL LAKE, WA, FOLLOWING RESTORATION BY ALUMINUM SULFATE TREATMENT,
Eastern Washington Univ., Cheney. Dept. of Biology.
S. M. Knapp, and R. A. Soltero.
Journal of Freshwater Ecology, Vol. 2, No. 1, p 1-12, March, 1983. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Trout, *Fish food organism, *Medical Lake, *Washington, *Lake restoration, *Aluminum sulfate, Eutrophic lake, Fish establishment, Trout farming, Lake fisheries, Water quality control.

After restoration by whole-lake applications of liquid aluminum sulfate, Medical Lake, Washington, received a total planting of approximately 31,000 fingerling rainbow trout (Salmo gairdneri) from 1978 to 1980. Prior to treatment the lake had been unable to support game fish. Post-treatment improvement in water quality and zooplankton standing crops permitted good trout survival and growth. Daphnia pulex comprised over 90 percent of the trout diet for most age classes and dominated the biomass of the 0+ age class. Size-selective predation was apparent for D. pulex 1.75 mm in length or larger. Intensive predation by trout appeared to be eliminating D. pulex as an available food source, which may jeopardize the effectiveness of the lake restoration as grazing on phytoplankton standing crop might diminish. (Author's abstract)
W84-02960

THE 'DECADE OF THE ENVIRONMENT' IN THE U.S.S.R.,
San Diego State Univ., CA. Dept. of Geography.
For primary bibliographic entry see Field 6G.
W84-02986

ADMINISTRATION LOSES ITS UMBRELLA AGAINST STANDFAST ACID RAIN POLICY,
L. Mosher.
National Journal, Vol. 15, No. 31, p 1590-1591, July, 1983. 1 Fig.

Descriptors: *Acid rain, *Political aspects, Legislation, Federal jurisdiction, Governmental interrelations, Legal aspects, Sulfur dioxide, Nitrogen oxides, Auto emissions, Exhaust.

On June 27, 1983, a group of nine nationally known scientists urged action be taken against acid rain, arguing that the risk of further environmental damage far outweighted the risk of acting on limited information, and that some of the information which had been requested by the government could never be supplied as the measurements needed for that information were not in use decades ago. A very major concern was over continuing damage to soil microorganisms caused by sustained acidification. However, response was slow in coming to this report. One basic problem is to determine how much sulfur dioxide emissions to reduce and where. Acid rain bills on Capitol Hill fall into three categories: those calling for more research, for reductions in sulfur dioxide emissions in the 31 state bordering on or east of the Mississippi River and for reduction of both sulfur dioxide and nitrogen oxides in all 48 states. There appears to be in increased political momentum building to support efforts to control acid rain. (Baker-IVI)
W84-03000

PROVIDING WATER SUPPLIES AND SANITATION FOR THE DEVELOPING WORLD,
For primary bibliographic entry see Field 6B.
W84-03101

POSSIBLE MEASURES FOR THE RESTORATION OF LAKE SEMPACH (MOGLICHE MASSNAHMEN ZUR RESTAURIERUNG DES SEMPACHERSEES),
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
R. Gachter, D. Imboden, H. Buhrer, and P. Stadelmann.
Schweizerische Zeitschrift Hydrologie, Vol. 45, No. 1, p 246-266, October, 1983. 13 Fig, 3 Tab, 14 Ref.

Descriptors: *Lake restoration, *Phosphorus, *Switzerland, *Lake Sempach, Hypolimnion, Aeration, Siphoning, Primary productivity, Wastewater treatment, Pollution load.

Lake Sempach is situated in the central part of Switzerland some 15 km NW of Lucerne. Since 1954 average orthophosphate and total phosphorus concentrations have increased twenty and eightfold respectively in Lake Sempach. As a consequence of increased primary production, pH values, supersaturation of oxygen, and differences in alkalinity between winter and summer increased in the epilimnion. The construction of wastewater purification plants which started in 1968 was insufficient to reduce the total phosphorus loading, although in 1977 58% of the population was connected to wastewater treatment plants. The lake is not in steady state with its phosphorus loading and the net deposition rate of phosphorus is not linearly related to the phosphorus content of the lake. This implies that linear steady state one-box models are unsuitable to describe the phosphorus balance of this lake. To estimate the effects of decreasing the phosphorus loading, hypolimnion aeration or hypolimnion siphoning, a nonlinear dynamic lake model is used. The model predicts that the defined water quality goals can only be achieved within the next 15 years if the external phosphorus loading is reduced by at least 50% and simultaneously lake-internal measures, such as hypolimnion aeration or hypolimnion siphoning are carried into effect. Siphoning is recommended in preference to aeration since this lake-internal measure requires much less energy and maintenance. (Moore-IVI)
W84-03174

WHAT PRICE AN UMBRELLA FOR ACIDIC RAIN,
P. Capes.
Process Engineering, Vol. 64, No. 5, p 29, 31-32, May, 1983. 1 Fig, 1 Tab.

Descriptors: *Acid rain, Sulfur dioxide, Industrial wastes, Powerplants, Water pollution control, England, Scandinavia, Fuels, Desulfurization.

As the principal source of atmospheric sulfur dioxide in the United Kingdom, it is likely that power stations would have to bear the brunt of any emission cuts resulting from current international discussion. The head of the CEGB's environmental section points to the absence of unequivocal evidence to suggest that the effects on Scandinavian forests are directly associated with sulfur dioxide emissions. The weight of the issue going against the CEGB is reviewed. To cut its own emissions by 30%, the CEGB would need to convert six fossil fuelled stations. Overall United Kingdom reductions of 30% would require that the Board convert a further four stations. Flue gas desulfurization, however, is not the only option available to CEGB. Pre-combustion washing of selected types of steam coal, selective importation of low-sulfur oil fractions are all possibilities. (Baker-IVI)
W84-03366

USE OF DISSOLVED OXYGEN MODELING RESULTS IN THE MANAGEMENT OF RIVER QUALITY,
Geological Survey, Reston, VA.
D. A. Rickert.
Journal of the Water Pollution Control Federation, Vol. 56, No. 1, p 94-101, January, 1984. 8 Fig, 2 Tab, 14 Ref.

Descriptors: *Water quality control, *Dissolved oxygen, *Model studies, Management, Planning, Water management, Willamette River, Oregon, River flow.

The dissolved oxygen (DO) regime was examined in the Willamette River, Oregon from 1973-1974 during which time a mathematical model was calibrated, verified, and used to project the effects on DO of a wide range of pollution loadings and flow conditions. Future achievement of DO standards in the Willamette River will require continued augmentation of summer low flows in addition to pollution control. Point-source loading of ammonia is the major cause of oxygen depletion in the modeled segment of river. Although DO levels in Portland Harbor are currently above the state standard, removal or partial reduction of a localized benthic demand would improve summer DO concentration. BOD loading from municipal wastewater treatment plants presently exerts a relatively small impact on DO. For the foreseeable future, there is no need for municipal, advanced waste treatment to protect DO levels in this river. Maintenance of a minimum low flow of 170 cubic meters/second and reduction of industrial ammonia loading are the important management needs. (Baker-IVI)
W84-03430

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

INTEGRATED RISK AND UNCERTAINTY ASSESSMENT IN WATER RESOURCES WITHIN A MULTIOBJECTIVE FRAMEWORK,
Case Inst. of Tech., Cleveland, OH. Center for Large Scale Systems and Policy Analysis.
Y. Y. Haimes.
Journal of Hydrology, Vol. 68, p 405-417, 1984. 37 Ref.

Descriptors: *Water resources development, *Risks, Water management, Management, Decision making, Planning, Probability distribution.

The process of risk-and-uncertainty assessment in water resources is examined using a multiobjective framework. Appropriate methodologies such as the surrogate worth trade-off (SWT) method, the multiobjective statistical method (MSM), the partitioned multiobjective risk method (PMRM), the risk dispersion index method (RDIM), and the

ncertainty sensitivity index method (USIM), are iscussed briefly. A need for an approach that tegrates the assessment of risk and uncertainty ithin a multiobjective framework is suggested, ccounting for random variables with both known nd unknown probability distributions. (Baker-IVI)
V84-03352

PTIMIZATION OF A TREE-LIKE WATER-UPPLY SYSTEM,
Edok-Eter-Mandilas Ltd., Athens (Greece).
. J. Kareliotis.
ournal of Hydrology, Vol. 68, p 419-429, 1984. 2 ig, 5 Tab, 4 Ref.

Descriptors: *Optimization, *Water conveyance, Systems analysis, Optimum development plans, Resources development, Planning, Water supply, Cost analysis.

The construction of water-supply schemes involves significant amounts of capital investment and therefore their planning in selecting the optimum layout constitutes a very important part in the process between their conception and the final execution of the project. An optimization method for the design of a tree-like water-supply system is presented. The system is divided into stages for a dynamic programming formulation and the state variables are defined to be pipe piezometric heads. The separation into stages is such that, for a given state, the optimum return is determined by applying linear programming. The optimum is defined as the minimum total cost of the system. The total cost consists of the cost of pumping equipment, pumping, storage reservoirs and the cost of pipes which can vary according to the pressure strength requirements. The developed approach is applied to an example water-supply system, where the estimate of the minimum total annual cost of the system is the objective. The example system solved and its dynamic programming formulation had a serial structure. Other systems with more than one source and/or elevated tanks and booster stations not in a series can be treated similarly by applying the dynamic programming technique for nonserial systems. The computation of the optimum for any given system can be performed very rapidly when a general linear programming program is available, since a computer solution of the mathematical equation of dynamic programming is not a difficult task. (Baker-IVI)
W84-03353

SOME MATHEMATICAL PROBLEMS IN OPTIMIZED PLANNING OF A WATER-RESOURCES SYSTEM,
East China Technical Univ. of Water Resources, Nanjing. Dept. of Hydrology.
Y. Bingru.
Journal of Hydrology, Vol. 68, p 431-442, 1984. 4 Fig, 5 Ref.

Descriptors: *Optimization, *Water resources development, Systems analysis, Planning, Mathematical equations.

The optimized planning of a water-resources system is usually carried out through constructing a mathematical model of the system, and is solved by systems analysis or methods of mathematical programming. For a general deterministic linear programming problem, the constraint condition usually consists of three types, viz. two kinds of inequality equations, and another of equality constraints. In solving such a problem with the Simplex method, usually some relaxation variables are introduced in order to find the initial feasible basic solution, as well as to reduce the mathematical model having inequality constraints, to the standard form of LP. A general method of generating the non-inferior set in multi-objective programming is also proposed. The idea of using the two-dimensional decomposition method is discussed and numerical examples are given for illustration. (Baker-IVI)
W84-03354

RURAL WATER-SUPPLY AND SANITATION PLANNING: THE USE OF SOCIOECONOMIC PRECONDITIONS IN PROJECT IDENTIFICATION,
CDM-WASH Project, Arlington, VA.
D. B. Warner.
Journal of Hydrology, Vol. 68, p 443-459, 1984. 2 Fig, 16 Ref.

Descriptors: *Planning, *Water supply development, *Sanitation, Rural areas, Socioeconomic factors, Developing countries.

Recognition of the socioeconomic preconditions for successful rural water-supply and sanitation projects in developing countries is the key to identifying a new project. The socioeconomic aspects of preconditions in the context of a five-step procedure for project identification are discussed. The procedure includes problem identification, determination of socioeconomic status, technology selection, utilization of support conditions, and benefit estimation. While the establishment of specific preconditions should be based on the types of projects likely to be implemented, a number of general relationships regarding favorable preconditions in water and sanitation planning are outlined. These relationships are used within the five step procedure to develop a set of general guidelines for the application of preconditions in the identification of rural water-supply and sanitation projects. (Baker-IVI)
W84-03355

A BINARY STATE DP ALGORITHM FOR OPERATION PROBLEMS OF MULTIRESERVOIR SYSTEMS,
Syracuse Univ., NY. Dept. of Industrial Engineering and Operations Research.
M. Ozden.
Water Resources Research, Vol. 20, No. 1, p 9-14, January, 1984. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Operating policies, *Reservoirs, Algorithms, Mathematical studies, Management, Decision making.

Reservoir operation problems are complicated by the nonlinearities in the objective functions. The dynamic programing (DP) procedure is often used to solve this problem because of the sequential nature of the decisions involved, but for simultaneous operations of multireservoir systems, other DP-based techniques are frequently found to be more efficient in overcoming the curse of the dimensionality problem caused by the interdependencies of the decisions. The DP-based procedure proposed performs better than other well-known techniques. The applications of this technique are presented in two different formulations for four-reservoir operation problems. The convergence properties of the algorithm are investigated as revealed from the systematic solutions of a control problem with various dimensions. The procedure enables the solution of moderately large systems within a reasonable computation time for the operation of multireservoir systems. (Baker-IVI)
W84-03407

6B. Evaluation Process

THE ALTAMIRA HYDRO COMPLEX IN THE AMAZON REGION,
A. T. Duarte, J. L. Pettena, and J. da Rocha Paes Filho.
International Water Power and Dam Construction, Vol. 35, No. 10, p 23-28, October, 1983. 5 Fig, 5 Tab.

Descriptors: *Dam construction, *Energy, *Brazil, *Altamira Hydro Complex, Powerplants, Construction, Design criteria, Planning, Evaluation, Economic aspects.

Principal results are given of the Hydroelectric Inventory Studies of the Xingu river basin, in the Amazon region of Brazil. The potential for installed capacity was more than 20,000 MW at an average cost of about US$1000/kW, realized with a maximum of seven sites developed at various drops along the river. At the two downstream developments which constitute the Altamira complex, it is possible to develop more than 14,000 MW of installed capacity at a cost of about US$750/kW. The lack of centers for local consumption and the large amount of energy which can be produced from the hydrocomplex of Altamira, mean that the tendency will be to export this energy in the future to other regions in Brazil in need of supplies. Based on current estimates the transmission costs of energy generated at the complex for the three load factors considered in the preliminary studies reveal them to be very attractive as they do not exceed US$7/MWh. (Baker-IVI)
W84-02995

MAGAT RIVER MULTIPURPOSE PROJECT,
National Irrigation Administration, Quezon City (Phillipines).
B. V. Viola, and V. C. Wilhelm.
International Water Power and Dam Construction, Vol. 35, No. 12, p 17-23, December, 1983. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Dam construction, *Design criteria, Flood control, Magat River, Philippines, Water resources development, Planning, Decision making, Evaluation, Typhoons, Earthquakes.

Basic design considerations, construction methods and the principal features of the Magat multipurpose development in the Philippines are discussed. The system will irrigate 102,000 ha of ricelands and generate 360 MW of power. Several factors played an important role in determining the location and the basic features of the Magat project. Bagabag, a large town in the potential reservoir area with a population of over 30,000 was, by government decision, not to be moved, thus restricting the elevation. High sedimentation rates called for extra storage to maintain the useful life of project. Other factors included the high seismicity of the area and the very high flood runoffs. Since the dam site itself is traversed by several faults which are considered potentially active, the structures had not only to be designed for high ground acceleration, but also for possible offset conditions. The Magat watershed is adjacent to the Baguio meteorological station. Typhoons create almost unbelievable runoffs and the Magat river, which at the dam site has an average flow of about 200 cu m/sec, has experienced a flood flow of 20,000 cu m/sec. The maximum inflow should be in the order of 34,500 cu m/sec. A spillway design capacity of 30,800 cu m/sec was planned. (Baker-IVI)
W84-02998

DEVELOPMENT OF WATER RESOURCES IN KOREA,
Industrial Sites and Water Resources Development Corp., Seoul (Korea).
J. C. Kim.
International Water Power and Dam Construction, Vol. 35, No. 12, p 23-25, December, 1983. 3 Fig, 3 Tab.

Descriptors: *Water resources development, *Dam construction, *Korea, Reviews, Water demand, Energy, Powerplants, Chungju Dam, Environmental effects, Government supports.

Korea has built enough dams to store 20% of the annual average runoff during the past 20 years. The Korean agriculture is based primarily on rice. Farmers begin planting in early April and harvest in October. Traditionally Koreans built small ponds and earth dams near their paddy fields so that the storage might cover the dry season for three months from April through June. Things began to change in 1945 with the Japanese invasion of Korea. The Japanese built higher earth dams so as to grow more rice for export to Japan and they began building high concrete dams incorporating hydro powerplants to provide industries with energy for manufacturing strategic materials for invading China. After the Korean war the country could not afford large investments in exploiting water power. A shift from light industry to heavy chemical manufacture in the 1960s brought about a power shortage and an increase in the demand for

water. South Korea has a total land area of about 99,000 sq km and an average annual precipitation of 1160 mm yielding a potential water resource of 114 x 10 to the 9th power cu m. Plans are underway to build the Chungju multipurpose dam, 97.5 m high with a storage capacity of 2.75 x 10 to the 9th power cu m bringing the current total storage capacity to 13.1 x 10 to the 9th power cu m. Environmental protection is being emphasized by the government and the government now requires an environmental survey before any civil engineering project is undertaken. (Baker-IVI)
W84-02999

A TIME SERIES APPROACH TO FORECASTING ANGLING ACTIVITY AT A RECREATIONAL SITE BASED ON PAST SUCCESSES,
Minnesota Univ.-Duluth. Dept. of Economics.
D. N. Steinnes, and R. L. Raab.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 40, No. 12, p 2189-2193, December, 1983. 2 Tab, 8 Ref.

Descriptors: *Time series analysis, *Forecasting, *Recreation, *Fishing, Fish management, Conservation, Mathematical models, Model studies, Model testing, Regression analysis, Cost analysis.

A multiple regression model was developed for estimating or forecasting the impact of past fishing 'successes' on the current angling activity or participation at a recreational site. The time series methodology is useful as a forecasting tool by investigating the lag structure of success and measuring its elasticity. The evaluated empirical results were based on daily time series data for Lester River, a Lake Superior river. The river was surveyed in Duluth, Minnesota in 1977 during the spring steelhead run on a regular basis to collect a systematic sample of 33 days during 2 months. The anglers respond more to past total success at the site than to past success per unit of effort at the site. The model could be extended to estimate the economic value of catching a fish. An extended model would be part of a comprehensive approach for valuing changes in habitat by using benefit-cost analysis with it. (Murphy-IVI)
W84-03024

APPRAISING WASTEWATER DISCHARGE COMPLIANCE LEVELS,
Allied Chemical Corp., Morristown, NJ. Corporate Research Center.
E. J. Shields.
Pollution Engineering, Vol. 15, No. 7, p 33-37, July, 1983. 1 Fig, 3 Tab.

Descriptors: *Wastewater disposal, *Monitoring, Compliance, Water analysis, Planning, Management.

Appraisals made of the compliance performance of wastewater discharging facilities made to date have largely been qualitative in nature, consisting of subjective evaluations which frequently use non-precise terms such as serious, substantial and significant to describe the levels of non-compliance that exist. A more meaningful technique for evaluating the performance of a facility in maximizing the compliance levels achieved by their wastewater dischargers would provide management with a useful control tool. The technique should provide a uniform approach for appropriately weighing frequency of excursions, pollutant parameters involved, degree to which the discharge limitations are exceeded, duration of the excursions, and the exposure to excursions posed by the amount of required testing. A description of the Allied Chemical Program which uses such a technique is presented. (Baker-IVI)
W84-03047

NEW BUSINESS OPPORTUNITIES,
Lorenz (William T.) and Co., Boston, MA.
W. T. Lorenz.
Pollution Engineering, Vol. 25, No. 9, p 32-36, September, 1983.

Descriptors: *Wastewater treatment, *Economic aspects, *Water treatment, Business opportunities, Management, Decision making, Planning, Financial aspects, Instrumentation, Water resources development.

New business opportunities in the water field are developing including those related to the following areas: water resource planning, development of resources, water treatment, wastewater treatment, wastewater reuse and recycling, transmission and storage, instrumentation, the agricultural market, the government market, the industrial market and the private market. Package wastewater treatment plants have gained a strong foothold in the complex area of industrial wastewater treatment. There are about 100 United States companies supplying such equipment and the competition is fierce in this aspect of water treatment. The total wastewater and water instrumentation market in 1985 is expected to reach $325 million. (Murphy-IVI)
W84-03050

CONTROLLING AGRICULTURAL SOIL LOSS IN ARKANSAS' NORTH LAKE CHICOT WATERSHED: AN ANALYSIS OF BENEFITS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Economics and Rural Sociology.
C. T. Osborn, and R. N. Shulstad.
Journal of Soil and Water Conservation, Vol. 38, No. 6, p 509-512, November-December, 1983. 2 Fig, 8 Ref.

Descriptors: *Erosion control, *Cost-benefit analysis, Water management, Recreation, Lakes, Financial aspects, Mathematical equations, Lake Chicot, Arkansas.

A unique environmental situation made it possible to estimate the recreational benefits of a soil erosion control project in the northern watershed of Lake Chicot, Arkansas. Using a discount rate of 7 and 3/8%, the estimated present value of benefits for the project over a 50 yr period is $67.7 million. Compared with the estimated present value of costs over the same period, $600,000, it is clear, at least from an efficiency standpoint, that the proposed soil erosion control project is overwhelmingly justified. Lake Chicot is, in reality, two lakes, side-by-side, separated by a man-made levee. The southern lake had become silty and turbid, drastically diminishing its recreational value. The purpose of the erosion control program was to prevent the same loss of recreational value in the north lake. Mathematical equations were developed relating hours per visit to travel cost, on-site cost, income, investment in recreational equipment, number of visits per year, number in parts, and age. These equations were developed for each basin of the lake. When all the information was gathered, dividing the present value of benefits for the program by the present value of costs yields a benefit-cost ratio of 112, which clearly justifies the undertaking of the proposed soil erosion control program. (Baker-IVI)
W84-03071

PROVIDING WATER SUPPLIES AND SANITATION FOR THE DEVELOPING WORLD,
R. Birenbaum.
Water and Pollution Control, Directory and Buyers' Guide, Vol. 121, No. 6, p 20-25, November, 1983. 4 Fig.

Descriptors: *Water supply, *Developing countries, *Sanitation, Wastewater, Drinking water, Planning, Evaluation, Decision making, Public health.

The United Nations declared the 1980s to be the International Drinking Water Supply and Sanitation Decade in which the goal was to provide safe drinking water and adequate sanitation to all people by 1990 for reasons of public health. A WHO survey listed manpower and finances as the two greatest restraints to meeting the goal. Canadian consultants who have started work overseas understand that the commitment to devising and maintaining high quality sanitation and water supply systems in a developing country requires trained personnel. One major problem area lies in the training of local personnel in the maintenance of whatever improvements are made. The installation of shiney new equipment is not necessarily the only nor the best answer to the problems that exist in these developing nations. (Baker-IVI)
W84-03101

CLEANER TECHNOLOGY: WHO GAINS FROM POLLUTION PREVENTION,
J. Elkington.
Process Engineering, Vol. 64, No. 5, p 24-26, May, 1983. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Industrial wastes, *Planning, Water pollution prevention, Management, Decision making.

The current status of clean technology is reviewed. Responses to a major industrial pollution problem include doing nothing and allowing the problem to continue unabated, closing the factory or plant, continuing discharging but in such a way that pollution is minimized, installing pollution control systems to remove the pollutants, develop and deploy cleaner and low waste technologies, and promote structural changes in the local, regional, or EEC economy. Last year the first batch of United Kingdom entries joined the UN Economic Commission for Europe's Compendium on Low and Non-Waste Technologies. The challenge is for Government and for the public sector agencies to ensure that the appropriate technologies are made available, by whatever route, to medium and small companies. (Baker-IVI)
W84-03365

ESTIMATING RESIDENTIAL FLOOD CONTROL BENEFITS USING IMPLICIT PRICE EQUATIONS,
Union Pacific Railroad, Omaha, NE.
For primary bibliographic entry see Field 4A.
W84-03392

MISSOURI RIVER - THE NEW COMPACTING GAME,
M. E. Harris.
Water Resources Bulletin, Vol. 19, No. 6, p 921-927, December, 1983. 4 Tab, 19 Ref. Northwest Area Foundation grant 785-0144A.

Descriptors: *River basins, *Water use, Missouri River, Interstate agreements, Water management, Water demand, Water resources development.

Proposed interbasin water diversions of the Missouri River are related to energy development, agricultural, municipal, and industrial water use. Overall, an estimated 8.5 million acre-feet of water from the Missouri River could be diverted by the year 2000 if three major projects are allowed to take place or continue. Interstate issues in the river basin include interbasin water diversions, riverbed and shoreline degradation, loss of recreational and natural areas, reduction in navigation capacity, the status of the Pick-Sloan Missouri Basin Program in terms of general river development, and the elimination of river basin commissions. An attempt to develop a comprehensive interstate water compact failed in the 1950s. Much of the concern over general river development lies in differing individual state attitudes towards the Pick-Sloan Missouri Basin Program. But, there are other available mechanisms for the resolution of the current political and legal differences among the ten river basin states. (Murphy-IVI)
W84-03396

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

MODELS FOR WATER REUSE AND WASTEWATER PLANNING,
California State Water Resources Control Board, Sacramento.
For primary bibliographic entry see Field 5D.
W84-03091

FUNDING MUNICIPAL WASTEWATER FACILITIES IN GEORGIA,
J. L. Ledbetter, J. C. Dozier, and W. K. Jordan.
Current Municipal Problems, Vol. 10, No. 2, p 206-212, Fall, 1983. 1 Tab.

Descriptors: *Grants, *Wastewater treatment facilities, Georgia, Economic aspects, Water pollution control, Industrial wastes, Municipal wastewater, Clean Water Act, Government finance, State jurisdiction, Construction Grants Program.

The Clean Water Program in Georgia is reviewed and updated. The principal sources of water pollution in that state are industries and publicly owned wastewater treatment works, with the latter being the more difficult to control, due more to lack of sufficient funds than to technical problems. The State has received about $610 million over the ten year history of the Construction Grants Program. There are approximately 67 wastewater treatment facilities that have been completed and were upgraded or totally constructed with monies appropriated under the Clean Water Act (PL 92-500). Additional funds are needed to insure that the momentum which has built up in the program will be maintained. However, serious reductions in funding levels for the State have made it clear that many of the communities currently invovled in planning and design activities may never receive funding for the actual construction of needed facilities through the Construction Grants Program. (Baker-IVI)
W84-03233

ESTIMATING DEMAND FOR INTAKE WATER BY SELF-SUPPLIED FIRMS,
Arkansas Univ., Fayetteville. Bureau of Business and Economic Research.
J. A. Ziegler, and S. E. Bell.
Water Resources Research, Vol. 20, No. 1, p 4-8, January, 1984. 3 Tab, 30 Ref.

Descriptors: *Water demand, *Pricing, Water supply, Industrial water, Water use, Statistical analysis, Economic aspects.

In many instances, heavy water-using firms use water from a self-supplied source such as a nearby lake, river, or well and do not purchase it from any private or public source. While these firms pay for the acquisition, treatment, and disposal of water, they do not pay a price determined in the market through the interaction of independent buyers and sellers but rather a price which reflects only firm costs and demands. The idea that there is no significant difference in the estimates of industrial water demand schedules when using either average or marginal cost as a proxy for price was examined. Water usage and cost information were obtained from questionnaires sent to paper and chemical plants in Arkansas, and two demand functions for intake water were calculated. F tests were performed to determine if each price variable made a significant contribution to its respective model. In addition, adjusted R(2), Mallow's statistic, and the PRESS statistic were calculated to determine best statistical fit and predictive capability. The findings indicated that both price variables made statisically significant incremental contributions to their respective models but that the model using AC explained a larger percentage of variance about the mean and was a better predictor. This relationship may change in the future as water becomes relatively more expensive and a larger part of total production costs. These circumstances may result in firms becoming more responsive to marginal water costs. (Baker-IVI)
W84-03406

6D. Water Demand

U.K. PUSHES R AND D TO MEET POTABLE WATER DEMAND,
J. Lock.
Consulting Engineer, Vol. 61, No. 5, p 72-73, November, 1983.

Descriptors: *Water supply development, *United Kingdom, *Potable water, *Water demand, Nitrates, Organic compounds, Lead, Drinking water, Plumbing, Water quality control.

Problems in the United Kingdom concerning water are similar to those in the United States: new towns and industrial estates must be supplied with water, and, simultaneously, old systems must be replaced or repaired. Public concern in the United Kingdom is mounting over trace organics and inorganics in the water supplies. Lead in potable water is a risk for the estimated 40% of the British people who still have lead plumbing. Nitrate concentrations in ground and surface waters are increasing. The total supply itself was shown to be a quickly reduced to a dangerously low level following the summer drought in 1976. Efforts are underway to increase the supply. (Baker-IVI)
W84-03001

CASCADE MODEL OF MONTHLY MUNICIPAL WATER USE,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. R. Maidment, and E. Parzen.
Water Resources Research, Vol. 20, No. 1, p 15-23, January, 1984. 5 Fig, 2 Tab, 28 Ref. Texas Dept. of Water Resources contract 14-10044.

Descriptors: *Water use, *Municipal water, Mathematical models, Climate, Seasonal variation, Autocorrelation, Probability, Canyon, Texas.

A time series model of monthly municipal water use is formulated as a set of equations representing the effects of four factors on water use: trend, seasonality, autocorrelation, and climatic correlation. The parameters of these equations are found by passing the water use time series through a cascade of four transformations; in each transformation the parameters of an equation associated with one factor are statistically determined and the series transformed to remove the effects of this factor. After the last transformation, only a random error series remains. Monthly municipal water use at Canyon, Texas, from 1961-1978 is modeled as an example. The model explains 86% of the variance of this series, divided among the four factors as trend (29%), seasonality (44%), autocorrelation (2%), and climatic correlation (11%). The random error is shown to be normally distributed by a nonparametric procedure characterizing probability families by their density quantile functions. (Author's abstract)
W84-03408

6E. Water Law and Institutions

FISHING RIGHTS: INDIAN FISHING RIGHTS AND CONGRESS: THE SALMON AND STEELHEAD CONSERVATION AND ENHANCEMENT ACT OF 1980,
J. P. Mentor, Jr.
American India Law Review, Vol. 9, No. 1, p 121-134, 1983. 94 Ref.

Descriptors: *Fishing, *Legal aspects, *Indian fishing rights, *Salmon, *Steelhead, Commercial fishing, Sport fishing, Pacific Northwest.

The Salmon and Steelhead Conservation and Enhancement Act of 1980 was passed to prevent the depletion of the salmon and steelhead resource of the Pacific Northwest. However, the act leaves unresolved the status of commercial fishing for steelhead, and thus does little to ease the tension between Indians and non-Indian sports fishermen. The Act does not preclude future abrogation of Indian treaty fishing rights. The Act establishes a coordinated, comprehensive management entity, the Salmon and Steelhead Advisory Commission, provides funding for both state and tribal enhancement projects, and provides for the purchase of non-Indian commercial fishing and charter vessels and their licenses by the state. The most significant contribution of the Act is the adoption of a comprehensive management plan. (Baker-IVI)
W84-02975

WATER RIGHTS: ABORIGINAL WATER USE AND WATER LAW IN THE SOUTHWESTERN UNITED STATES: WHY THE RESERVED RIGHTS DOCTRINE WAS INAPPROPRIATE,
A. E. Ross.
American Indian Law Review, Vol. 9, No. 1, p 195-209, 1983. 54 Ref.

Descriptors: *Water rights, *Legal aspects, *Indian water rights, Aboriginal title, Riparian rights, Property rights, Southwestern United States.

Whether the Indians of the Southwest ought to have received aboriginal title to water rights by way of their existing use of the water is examined. The evolution of the doctrine of aboriginal title is discussed and the Winters doctrine of reserved rights is explored. The evidence of the native cultural traditions is surveyed to determine if aboriginal rights should have been acknowledged, or whether the Winters doctrine gave the Indians water rights previously unearned under common law. (Baker-IVI)
W84-02976

THE THIRD WAVE IN WATER QUALITY MANAGEMENT,
R. J. Foxen.
Civil Engineering, (New York), Vol. 53, No. 4, p 43-45, April, 1983.

Descriptors: *Cost-benefit analysis, *Tertiary wastewater treatment, *Water quality management, *Water law, *Future planning, Capital costs, Cost analysis, Benefits, Secondary wastewater treatment, Water quality control, Water quality standards.

In the 1970's, there was great public pressure on the Environmental Protection Agency (EPA) to clean up water polluting discharges by methods of advanced wastewater treatment (AWT), no matter what the cost. In response to this pressure, Congress passed the Clean Water Act in 1972, which fostered adoption of AWT technology to improve water quality. A review of some AWT projects of the 1970's showed that some of them were not very cost effective. EPA funding was subsequently denied for some projects that would do little to improve water quality but would require great capital expenditures. Many groups have questioned the legality of AWT project reviews, stating that environmental impact and not cost savings should be the area of major concern. An amendment to the Act in 1966 (301h) allowed less than secondary treatment to marine wastewater discharges if it could be proven that minimum water quality standards would not be violated. In the early 1980's, increased demands to lessen government spending and increased burdens on taxpayers caused decreased local funds to finance AWT projects. The 301h waiver could be used in the future to meet minimum water quality standards in certain areas and provide more stringent AWT requirements only in areas where needed to promote economic efficiency by better use of public funds. (Geiger-FRC)
W84-02980

SPORHASE V. NEBRASKA EX REL. DOUGLAS: A CALL FOR GROUND WATER LEGISLATION,
J. M. Crane.
Denver Law Journal, Vol. 60, No. 4, p 631-643, 1983. 124 Ref.

Descriptors: *Groundwater, *Legal aspects, *Nebraska, *Legislation, Water export, Water import, Interstate commerce.

The Supreme Court, in its decision in the case of Sporhase vs Nebraska ex rel. Douglas, held that state water anti-export statutes are contrary to the commerce clause of the federal Constitution. This decision brings water regulations within the scope of the Court's previous pronouncements on state statutes regulating interstate commerce in animal, vegetable, and mineral resources. The development of the commerce power is outlined as it relates to state export/import restrictions, and the Court's rational in this decision in the context of

commerce clause precedent is examined. The Court's characterization of water is analyzed, and probable effects of this holding on future interstate water allocation plans will be projected. This comment takes the position that some state regulation of groundwater export is possible after Sporhase. (Baker-IVI)
W84-03003

WHEREVER THE WATER FLOWS: LYON APPLIES THE PUBLIC TRUST TO NON-TIDAL WATER,
B. Seldon.
Ecology Law Quarterly, Vol. 11, No. 1, p 21-45, 1983. 145 Ref.

Descriptors: *Public trust doctrine, *Land use, *Shores, Legislation, Legal aspects, California, Lakes, Rivers, Swamps, Wetlands.

Lands between high and low watermarks along the shores of all navigable water in California are subject to the public trust. Some of the land is subject to the public trust even though it was patented as swamp and overflowed land. Many of the lands subject to the trust have been filled or improved despite their trust status. The more equitable way to deal with these lands is to balance the interests of the public and the landowner on a case-by-case basis, as the California Supreme Court directed with tidelands in City of Berkeley. The uncertain nature of trust purposes and their tendency to conflict with each other lead to uncertain expectations among landowners affected by the public trust. Some of this uncertainty could be dispelled by regional planning, which would give each landowner an indication of what used he may make of his property without being found in conflict with a trust purposes. (Baker-IVI)
W84-03004

EQUITABLE DISCRETION UNDER THE FEDERAL WATER POLLUTION CONTROL ACT: WEINBERGER V. ROMERO-BARCELO,
California Univ., Berkeley. School of Law.
J. Petruzzi, and M. Thomas.
Ecology Law Quarterly, Vol. 11, No. 1, p 73-94, 1983. 192 Ref.

Descriptors: *Water pollution control, *Water Pollution Control Act, *Puerto Rico, Coastal waters, Equitable discretion, Legal aspects, Navy, Permits, Effluents.

Congress substantially amended the Federal Water Pollution Control Act (FWPCA) in 1972 to provide for a detailed permit system establishing individual compliance schedules for effluent discharge sources. United States Navy training in Puerto Rico has since 1970 been responsible for dumping much material into the coastal waters surrounding that island. Eventually the Supreme Court became involved in light of the statutory background of the FWPCA and case law concerning federal court exercise of equitable discretion. The text and legislative history of the Act require that a permit be obtained prior to the discharge of pollutants into navigable waters. In addition, previous Supreme Court decisions suggest that federal courts are without power to allow an ongoing violation of a statutory command. The Romero-Barcelo decision greatly changes the comprehensive regulatory program devised by Congress. That decision permitted the Navy to continue its discharges without a permit or a Presidential exemption. This decision may have the unfortunate consequence of encouraging violators of the Act to wait until they are sued before applying for a permit. (Baker-IVI)
W84-03005

MANAGING AGRICULTURAL POLLUTION,
Pennsylvania Univ., Philadelphia. Dept. of City and Regional Planning.
J. C. Keene.
Ecology Law Quarterly, Vol. 11, No. 2, p 135-188, 1983. 2 Tab, 327 Ref.

Descriptors: *Water pollution control, *Agriculture, Legal aspects, Legislation, Common law nuisance, Nuisance, Farm wastes, Land use.

Several major approaches to managing agricultural pollution are reviewed, including judicial resolution of land use conflicts based on principles of common law nuisance; recent legislative attempts to limit the application of those principles by the enactment of right-to-farm laws; technology-forcing regulation; and spatial separation of agricultural activities from land uses with which they conflict, by the creation of agricultural districts or comprehensive farmland protection programs. The essence of the law of private nuisance is that it involves the application of a set of general principles to a particular set of circumstances. The court must decide whether there is a substantial interference, whether the social value of one activity outweighs that of another, which of two uses is more appropriate for a particular neighborhood, and whether the harm can be either avoided or prevented at relatively little cost. The strengths of this process are that a landowner can do what he wants with his property so long as he does not interfere unreasonably with the rights of his neighbor, and that landowners can take advantage of developments in technology. (Baker-IVI)
W84-03006

SPORHASE V. NEBRASKA: THE MUDDYING OF COMMERCE CLAUSE WATERS,
California Univ., Berkeley. School of Law.
A. D. Greenberg.
Ecology Law Quarterly, Vol. 11, No. 2, p 215-239, 1983. 176 Ref.

Descriptors: *Legislation, *Ownership of water, Federal jurisdiction, Regulations, States rights, Water law, Water transfer.

The Sporhase opinion and the validity of state efforts to regulate interstate transfers of water are examined. Discussions center on the development of the state ownership exemption from Commerce Clause analysis, the Sporhase opinion, and the decision. In Sporhase, the Supreme Court attempted to balance the Commerce Clause goal of national unity with the traditionally strong local interest in water resource regulation. Water law is most efficient when made at the local level, and is a legitimate exercise of the police power of the state. Thus each state determines its own water rights doctrines with little interference from the federal government. Neither the presence of detailed state regulatory programs nor the importance of the resource justifies a departure from standard constitutional analysis. The Court can recognize the legitimacy of state water law by requiring all nonresidents to comply with standards a state establishes for its citizens. Resident preferences justified on the grounds of conservation and preservation goals invite the strictest scrutiny of the court. By implying that courts may decline this invitation when reviewing water laws, the Supreme Court in Sporhase provided little guidance to those who must draft and enforce such laws, and added confusion to an already unsettled state ownership doctrine. (Baker-IVI)
W84-03007

SO ITS NOT 'OURS' - WHY CAN'T WE STILL KEEP IT; A FIRST LOOK AT SPORHASE V. NEBRASKA,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Land and Water Law Review, Vol. 18, No. 1, p 137-174, 1983. 121 Ref.

Descriptors: *Legislation, *States rights, Ownership of water, Federal jurisdiction, Regulations, Nebraska, Water transfer.

The United States Supreme Court's decision in Sporhase v. Nebraska is examined. The implications the decision has for western states' attempts to control their water resources are noted and a revision in the Court's approach to such questions is suggested. An approach is presented within the framework of Sporhase to export statutes that allows a state to assert its essential interests in determining the locus of water use. This effort is animated by the normative argument that there is no basis for federal preemption of state water law in this or any other energy issue. A process-based approach is suggested for western water law such that it suggests a case against judicial interference in water allocation choices when the risks of a malfunction in the political process are low. To continue to allow the states to allocate their water resources, courts need to avoid formulation too many hard and fast rules about the duty to share scarce waters among interested states. Existing principles of law provide a sufficient context for the political process to function to determine interregional equity issues. (Baker-IVI)
W84-03008

WETLANDS PRESERVATION, FISH AND WILDLIFE PROTECTION, AND 404 REGULATIONS: A RESPONSE,
Lewis and Clark Coll., Portland, OR. Natural Resources Law Inst.
M. C. Blumm.
Land and Water Law Review, Vol. 18, No. 2, p 469-489, 1983. 112 Ref. NOAA grant NA 81AA-D-00086.

Descriptors: *Legislation, *Permits, *Wetlands, *Wildlife, Water pollution control, Clean Water Act, Regulations, Economic aspects, Legal aspects.

The permit program established by section 404 of the Clean Water Act is defended against the charges of bureaucratic red tape and over-regulation. The value of wetlands and fish and wildlife are viewed as warranting a broad 404 jurisdictional mandate and a pluralistic review process designed to assure that the benefits of aquatic developments exceed their costs. It is argued that the existing 404 program, grounded on widespread intergovernmental and public review, has both preserved important ecosystems and produced more cost-effective developments. However, the wisdom and the legality of a recent expansion in the use of general permits is questioned and a number of suggestions to increase the effectiveness of the program are made. (Baker-IVI)
W84-03009

SPORHASE V. NEBRASKA EX REL. DOUGLAS: STATE CONTROL OF WATER UNDER THE CONSTRAINTS OF THE COMMERCE CLAUSE,
A. B. Tallmadge.
Land and Water Law Review, Vol. 18, No. 2, p 513-537, 1983. 157 Ref.

Descriptors: *States rights, *Legislation, *Groundwater, Ownership of water, Legal aspects, Nebraska, Commerce clause, Water transfer.

The Sporhase decision, for the first time, saw the Supreme Court declaring that groundwater is an article of commerce, and is therefore susceptible to congressional regulation. The Court further held that a Nebraska statute which prohibited the export of water to any state that did not provide reciprocal rights violated the commerce clause of the United States Constitution. This decision has prompted much anxiety in the western states causing some legislatures to consider new or amended water laws which will constitutionally justify restrictions on the use of water for interstate commerce. (Baker-IVI)
W84-03010

CONSTITUTIONAL LAW - WATER LAW - CONSTITUTIONALITY OF WATER EXPORT BANS AND LIMITATIONS ON INTERSTATE WATER ALLOCATION. SPORHASE V. NEBRASKA EX REL. DOUGLAS, - U.S. -, 102 S. CT. 3456 (1982),
J. Kelly.
Land and Water Review, Vol. 18, No. 2, p 553-573, 1983. 107 Ref.

Descriptors: *Legislation, *Water export, Water import, Legal aspects, Water supply development, Groundwater, Nebraska, Ownership of water, States rights, Federal jurisdiction, Water transfer.

n reviewing the Sporhase decision it may appear t first to cripple the states in their efforts to preserve and conserve scarce water resources. The Court's definitive characterization of ground water s an article of commerce clearly limits the states' power to regulate in this critical area, and at the ame time, opens the floodgates to ground water egulation by Congress. A closer look, however, eveals that state power to regulate ground water as not been severely curtailed. In fact, the Sporase Court recognized that the states should be afforded considerable latitude when drafting ground water legislation. As long as the states either refrain from implementing overly discriminatory legislation or are granted congressional authorization to do so, the Court indicated that it would continue to place substantial weight on state conservation interests. It may happen in the future that arid Western states may become net water importers to insure plentiful water supplies. The Court's emphasis on state interests and non-discriminatory legislation, as evidenced in this decision, is a victory for these states. (Baker-IVI)
W84-03011

NORTH DAKOTA CENTURY CODE SECTION 47-01-15: DETERMINING NORTH DAKOTA'S INTEREST IN THE BEDS OF NAVIGABLE WATERS,
M. G. Fiergola.
North Dakota Law Review, Vol. 59, No. 2, p 211-240, 1983. 208 Ref.

Descriptors: *North Dakota, *Navigable waters, *Ownership of beds, Riparian land, Public trust, Constitutional law, State sovereignty.

The State of North Dakota entered the Union on an equal footing with the original states and acceded to sovereignty over the beds of navigable waters within the state. The beds of navigable waters are sovereign public trust lands of the State of North Dakota. Because these beds are subject to the public trust doctrine, the State has a duty to protect the public interest in these lands. Nevertheless, the North Dakota Supreme Court has interpreted a state statute to grant that portion of the beds between the high and low water marks to riparians. Such an interpretation is contrary to a provision of the North Dakota Constitution, which prohibits the State from giving away state property. Therefore, the State of North Dakota should plead and the courts should address this ownership issue so that the public interest in the State's sovereign lands may be protected. (Moore-IVI)
W84-03012

SPORHASE V. NEBRASKA EX REL. DOUGLAS: DOES THE DORMANT COMMERCE CLAUSE REALLY LIMIT THE POWER OF A STATE TO FORBID (1) THE EXPORT OF WATER AND (2) THE CREATION OF A WATER RIGHT FOR USE IN ANOTHER STATE,
C. E. Corker.
University of Colorado Law Review, Vol. 54, No. 3, p 393-445, 1983. 179 Ref.

Descriptors: *Water rights, *State jurisdiction, *Groundwater, *Water export, *Nebraska, *Colorado, Overlying proprietor, Eminent domain, Commerce clause, Water management.

In the case of Sporhase v. Nebraska ex rel. Douglas, the U. S. Supreme Court ruled that a state statute which forbids export of groundwater to another state because the latter would deny reciprocity is unconstitutional. It is felt that the Court failed to understand the basic necessities, rooted in laws of the physical universe, which demand active local government management of water resources. The Court failed to articulate dormant commerce clause which can accomodate the diverse and local necessities of a federal union of continental size. Groundwater law, and its administration and management under government regulation is only one example of a problem that must be dealt with locally. Numerous cases are cited demonstrating water management decisions by state and federal agencies which affect inter-state water resources. Water is discussed here not as a commodity but rather as a management challenge requiring expert understanding of the geological implications and national concerns of managing this resource. (Wheatley-IVI)
W84-03013

TOWARD A UNIFIED REASONABLE USE APPROACH TO WATER DRAINAGE IN WASHINGTON,
G. C. Sisk.
Washington Law Review, Vol. 59, No. 1, p 61-85, 1983. 233 Ref.

Descriptors: *Reasonable use, *Drainage, *Washington, Legal aspects, Common enemy rule, Land use, Diversion.

Almost any development of land is likely to alter the flow of water draining from the land to the possible harm of neighboring property. Washington has traditionally applied both the common enemy doctrine allowing diversion of diffuse surface water drainage with impunity and a strict liability standard prohibiting injurious obstruction or diversion of watercourses and natural drains. A reasonableness doctrine applied consistently and uniformly to all drainage water however characterized, would provide recovery to landowners suffering from an unreasonable invasion of excessive water depriving them of the free use and enjoyment of their property. A reasonable use doctrine would balance the reasonableness of the defendant's conduct and use of land against the results of the harmful interference with the flow of both diffuse and channeled waters. It would be appropriate for the Washington legislature to adopt a unified standard of reasonableness for water drainage law. (Murphy-IVI)
W84-03014

THE POLITICS OF WETLAND CONSERVATION: A WILDLIFE VIEW,
K. W. Harmon, and C. A. McConnell.
Journal of Soil and Water Conservation, Vol. 28, No. 2, p 92-95, March-April, 1983. 2 Fig.

Descriptors: *Political aspects, *Policy making, *Wetlands, Conservation, Soil conservation, Water conservation, Legislation.

Political action at many levels plays a major role in the competition between public and private views of wetlands. In general, attitudes toward wetlands have changed in the past two decades, most noticeably at the federal level, less so in the states and locally. Of the many legislative efforts considered in this area, Section 404 has caused a significant amount of debate. However, attempts to undermine two decades of gains in balancing wetland protection with economic activity are not restricted to 404 and the Corps of Engineers. The US Department of Agriculture has retreated in its demands. The administration's resolve to resurrect a laissez-faire approach to management of finite resources is illustrated in its proposal to repeal the Principles and Standards for Planning Water and Related Land Resources and issue them as guidelines. (Baker-IVI)
W84-03054

MANAGEMENT OF GROUNDWATER THROUGH MANDATORY CONSERVATION,
M. J. Kelly.
Denver Law Journal, Vol. 61, No. 1, p 1-24, 1983. 131 Ref.

Descriptors: *Groundwater management, *Legal aspects, Overdraft, United States, Public rights, Pumping, Restrictions.

Groundwater overdraft is a serious problem in many parts of the United States. The prevailing common law and statutory groundwater property systems do not provide a satisfactory means of controlling groundwater overdraft. The introduction of constraints on pumpers may force existing groundwater users to reduce their pumping, but it would not constitute a taking requiring compensation. While there are precedents suggesting otherwise, application of such restrictions to existing groundwater users is not viewed as an illegal, uncompensated taking of private property. Both the public rights theory and more traditional takings theories support this result. The public rights theory holds that when uses of property have mutually incompatible spillover effects, the government can restrict either use without affording compensation. Under the diminution in value theory, the government is not required to compensate unless its restrictions on property cause such a large decrease in property value that the owner suffers total or near total economic loss. (Murphy-IVI)
W84-03234

WATER RIGHTS FOR EXPANDED USES ON FEDERAL RESERVATIONS,
Air Force Academy, CO.
K. S. Samelson.
Denver Law Journal, Vol. 61, No. 1, p 67-76, 1983. 73 Ref.

Descriptors: *Water rights, *National parks, Colorado, New Mexico, Forests, Parks, Prior appropriation, National Park System.

In November of 1982 the Colorado Supreme Court decided United States vs City and County of Denver, a leading case in the area of federal reserved water rights. The major issue addressed was the claim of the US for reserved water rights for national forests and national parks. Alternatives to the decision are explored from a legal and practical standpoint and a framework for resolving the conflict is presented. The dissent in US vs New Mexico asserted that the ruling denying additional reserved water rights for national forests with a 1960 priority date was dictum. The Colorado Supreme Court was of the opinion that that ruling was binding even if dictum. In the future the courts may realize that the leeway to grant additional water for federal reservations with expanded purposes exists. (Baker-IVI)
W84-03235

BASELINE DELIMITATIONS AND MARITIME BOUNDARIES,
Rhode Island Univ., Kingston. Center for Ocean Management Studies.
L. M. Alexander.
Virginia Journal of International Law, Vol. 23, No. 4, p 503-536, Summer, 1983. 8 Fig, 188 Ref.

Descriptors: *Legal aspects, *Boundaries, Boundary disputes, Water boundary, Law of the Sea, 1982 Convention, Coastal waters, State jurisdiction.

The official baseline along the coast is an important juridical feature of a state. The regulations for delimiting baselines are contained in articles 5 through 14 of the 1982 Convention. Although the articles have received general recognition as having the status of customary international law, certain ambiguities remain in the wording of some provisions. These ambiguities and apparent inconsistencies of action are explained and then baseline conditions are related to selected maritime boundary situations. (Baker-IVI)
W84-03237

6F. Nonstructural Alternatives

PRIVATE ENFORCEMENT OF FEDERAL ANTIPOLLUTION LAWS THROUGH CITIZEN SUITS: A MODEL,
D. A. Feller.
Denver Law Journal, Vol. 60, No. 4, p 553-571, 1983. 141 Ref.

Descriptors: *Water pollution control, *Public opinion, *Law enforcement, Legislation, Legal aspects.

The history of citizen suits brought directly against polluters provides little indication of how a continuous, organized program of litigation would fare as a public interest enterprise. The stage is set for a systematic attempt to privately enforce environmental statutes. The evolution of federal adminis-

trative machinery in support of those laws has created a store of discovery materials on which citizens may draw to identify and assemble cases. This is the cornerstone of any future private enforcement venture. The EPA reporting machinery facilitates selection of violations and significantly reduces the costs of discovery. The judiciary seems favorably disposed to the award of attorneys fees to plaintiffs bringing effective or useful citizen suits. Though it is impossible to state with any certainty that courts will allow all plaintiffs the full value of the fees and costs incurred in litigation, it is clear that courts are currently more willing to make such awards than at any time in the past. As a result, the financial deterrents are less threatening than in previous years. These favorable mechanical factors create the opportunity for an effectively organized and conducted private enforcement group to operate. (Baker-IVI)
W84-03002

WATER SUPPLY: A STATE OR LOCAL PROBLEM,
SCS Engineers, Inc., Reston, VA.
L. L. Guy, Jr.
Current Municipal Problems, Vol. 10, No. 2, p 200-205, Fall, 1983.

Descriptors: *Water supply, *State jurisdiction, *Local governments, Planning, Decision making, Management.

Problems in the municipal area of Washington, D.C. are briefly reviewed. Water supply development and protection is viewed in the main as a local responsibility and should not be given over to the federal government. Federal control seems to result in long delays. The easiest problems to solve are the technical ones. The most difficult appear to be the political ones. An agreement is presented which has been devised in Northern Virginia, building on the awareness of the local elected officials that only they could deal with the problems of adequate water supply. This agreement has four parts: regional cost and benefit sharing for the Bloomington Reservoir, regional sharing of the cost and benefits for the proposed Little Seneca Reservoir, a regional operating agreement directed by the Interstate Commission's CO-OP Computer Program to coordinate withdrawals from each of the reservoirs and the Potomac, and modifications to the existing Potomac low flow allocation agreement. (Baker-IVI)
W84-03232

A LAND-USE POLICY BASED ON WATER SUPPLY,
Wilson (Lee) and Associates, Inc., Santa Fe, NM.
L. Wilson.
Water Resources Bulletin, Vol. 19, No. 6, p 937-942, December, 1983. 1 Fig, 2 Tab, 2 Ref.

Descriptors: *Land use, *Policy, *Zoning, *Groundwater storage, Groundwater mining, Groundwater recharge, Lot size, Water use, Water supply development, Groundwater management, Santa Fe county, New Mexico.

Santa Fe County, New Mexico, has adopted a land-use policy in which zoning densities provide a balance between the water use on a parcel of land and the water supply available beneath that land. In two of four mapped hydrologic zones, ground water in storage will be allowed to be mined to exhaustion in 100 years (40 years in urban areas). Elsewhere, the policy is for a steady state with use balanced by recharge. Equations to determine storage or recharge can be solved using site specific data or regional estimates of hydrologic conditions. Substantial reductions in the lot size requirements are allowed if water conservation convenants are adopted. Public acceptance indicates that the policy successfully integrates technical and political concerns. It is simple to administer, yet reflects widely expressed public goals and values. (Author's abstract)
W84-03398

ASSESSING LAND-USE REGULATIONS IN COASTAL WETLANDS: THE CASE OF THE LONG POINT AREA, LAKE ERIE, ONTARIO,
British Columbia Univ., Vancouver.
S. Jessen, J. C. Day, and J. G. Nelson.
Coastal Zone Management Journal, Vol. 11, No. 1-2, p 91-115, 1983. 4 Fig, 6 Tab, 35 Ref.

Descriptors: *Coastal zone management, *Wetlands, *Land use, *Regulations, *Lake Erie, *Ontario, Planning, Permits, Floods, Erosion, Lake shores.

The Haldimand-Norfolk Region is subject to high potential coastal flooding and erosion hazards which pose severe management problems. The 1976 lakeshore regulation policy adopted by the Regional Municipality of Haldimand-Norfolk was aimed at directing development into areas less susceptible to flood and erosion hazards. This innovative strategy was initiated at the municipal level as a component of the regional land-use planning process. Determination of efficiency and effectiveness of the policy implementation process is based on analysis of permit approval files. All development applications submitted between 1976 and 1980 in the Turkey Point and Long Point Peninsulas are evaluated. Those areas, the most popular cottaging areas in the region, are most susceptible to flood and erosion hazards. Of the total applications submitted during the four-year study period, 37% were in these areas. The policy was ineffective and inefficient in controlling development in the two peninsulas. Applications were approved in the majority of cases, despite regulatory prohibition of developments in hazard-susceptible areas. A high percentage of applications involved some type of addition to existion infrastructures, such as extensions to buildings and addessory buildings. Such applications, while not creating new primary development, increased the potential loss as a result of flooding and erosion if approved. The time necessary to arrive at final decisions was lengthy, and the process was inefficient. The inefficiency may partially explain the ineffectiveness of the policy in controlling development. The lengthy delays encountered may have led many to apply for permits only after they had violated the regulations by constructing the proposed developments. (Moore-IVI)
W84-03425

6G. Ecologic Impact Of Water Development

THE 'DECADE OF THE ENVIRONMENT' IN THE U.S.S.R.,
San Diego State Univ., CA. Dept. of Geography.
P. R. Pryde.
Science, Vol. 220, No. 4594, p 274-279, April, 1983. 1 Fig, 36 Ref.

Descriptors; *Environmental protection, *Water pollution control, USSR, Russia, Seas, Industrial wastes, Industrial discharges, Lakes, Lake Baikal, Irrigation, Consumptive use, Water levels, Caspian Sea, Volga River.

The state of resource conservation and environmental protection in the USSR is examined as it stood at the beginning of the 1980's as compared to the early 1970's. Much environmental improvement took place over the past 10 years. Two economic events in the 1970's were responsible for some of the changes. First, there was a general downturn in what had been for three decades an unbroken and vigorous rate of industrial expansion. Second, there were worldwide energy crises in 1973 and 1979. A call was made for a more efficient use of natural resources. An increased emphasis on recycling, including that of municipal wastes, has thus taken place during the past 10 years. During the 1970-1980 decade attention was directed toward the Caspian Sea problem, Lake Baikal, poaching, land reclamation, and the broad topics of air and water pollution. An underlying reason for the gloomy outlook of many environmentalists in the USSR can be found in the decidedly utilitarian approach to the natural environment espoused by many senior Soviet planning officials and even academicians. Even after two decades of concern over Lake Baikal, the future of this vast resource of clean water is far from secure. Some steps have been positive. In most major cities primary treatment plants have been built and in some cases even secondary treatment facilities are available. Management of water quality and quantity in the Volga-Caspian basin has made progress. The reduction of the water surface level at the Caspian Sea due to the creation of upper basin reservoirs and lower basin irrigation projects has received attention, and progress is being made. A relatively newer issue of similar scope concerns the Sea of Azov. (Baker-FRC)
W84-02986

GEOTHERMAL EFFECTS ON STREAM BENTHOS: SEPARATE INFLUENCES OF THERMAL AND CHEMICAL COMPONENTS ON PERIPHYTON AND MACROINVERTEBRATES,
California Univ., Berkeley. Div. of Entomology and Parasitology.
For primary bibliographic entry see Field 5C.
W84-03019

THE NORTHWEST'S HYDROELECTRIC HERITAGE: PROLOGUE TO THE PACIFIC NORTHWEST ELECTRIC POWER PLANNING AND CONSERVATION ACT,
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
M. C. Blumm.
Washington Law Review, Vol. 58, No. 2, p 175-244, April, 1983. 386 Ref.

Descriptors: *Reviews, *Hydroelectric power, Powerplants, New Deal, Federal jurisdiction, Columbia River Treaty, Hanford Agreement, Bonneville Project Act.

This review describes the development of hydroelectric power in the Northwestern section of the United States. Emphasis is given to the pre-New Deal era (specifically the twenties); the New Deal (including regulation of holding companies, the public-power crusade, the struggle over centralized planning, the Bonneville Project Act, and postage stamp rates and rural electrification); the War and its aftermath (including planning for the post war era, BPA as a regional chamber of commerce, and the defeat of the Columbia Valley Authority); the partnership years (nonfederal project development); the golden age (including doubling of industrial power sales, the Columbia River Treaty, and the Hanford Agreement); the rise and fall of the hydro-thermal power program; and a looking backward section including input in the enlarged mandate, the Fish and Wildlife Program, allocation of power entitlements and the regional energy plan. (Baker-IVI)
W84-03030

DUGOUTS IN EASTERN SOUTH DAKOTA: THEIR LOCATION IN RELATION TO BASIN WETLANDS AND STREAMS,
South Dakota Cooperative Wildlife Research Unit, Brookings.
K. B. McPhillips, L. D. Flake, W. A. Wentz, and R. L. Linder.
Journal of Soil and Water Conservation, Vol. 38, No. 5, p 434-436, September-October, 1983. 1 Fig, 2 Tab, 17 Ref. Federal Aid in Wildlife Restoration Program project W-75-R. South Dakota Agricultural Experiment Station project 7216-615. WRI project A-038-SDAK.

Descriptors: *Ponds, *Wetlands, *Environmental effects, Drainage, Dugouts, South Dakota, Streams, Drainage basins.

An estimated 55,855 dugouts existed in eastern South Dakota in 1976. About 77% of these were located in wetland basins or streams. An analysis of dugout location in reference to wetland class and wetland numbers relative to class suggests a need for recommendations on dugout placement to minimize effects of the structures on wetlands. Dugout location in relation to numbers of ephemeral, temporary, seasonal and semipermanent wetlands were most likely present in seasonal and semipermanent basins, followed by temporary and ephemeral ponds. The disruption of local natural hydrologic

gimes in the area of the dugout may be so tensive that wetland vegetation can no longer rvive outside of the dugout boundaries. Soil conrvationists, wildlife managers, and others who ake recommendations to landowners and others ould be cognizant of the potential problems in igout construction in wetlands. (Murphy-IVI)
84-03067

IOLOGY OF THE ARCTIC GRAYLING, THYMALLUS ARCTICUS (THYMALLIDAE), IN 'ST' - ILIM RESERVOIR,
kutskii Gosudarstvennyi Univ. (USSR).
e. S. Kupchinskaya, B. S. Kupchinskiy, L. N. yzhova, P. Ya. Tugarina, and L. I. Tyutrina.
ournal of Icthyology, Vol. 23, No. 1, p 47-56, 983. 7 Tab, 12 Ref.

escriptors: *Fish behavior, *Reservoirs, Environental effects, Water resource development, Ust'-lim, Graylings.

ome ecological and physiological peculiarities growth rate, feeding, condition factor, fecundity, lood composition, fatness) of the arctic grayling Thymallus arcticus) of Ust'-Ilim Reservoir (East iberia) may help determine the viability of Grayl-ng in Ust'-Ilim reservoir. The grayling were retricted mainly to the upper section of the reser-oir where conditions close to river conditions ave been preserved, and to backwater zones in ributaries. The growth of the grayling in the reser-oir is similar to the growth of fish in the river in his section prior to regulation of the discharge. he food composition has changed: under reser-oir conditions the grayling feeds on Amphipoda nd the larvae of Chironomidae. The blood and atness indices of the grayling in Ust'-Ilim reservoir ndicate high viability. Its abundance has decreased oticeably. This is connected with regulation of he discharge which has provoked a change in the complex of abiotic and biotic factors. An increase n grayling stocks in the reservoir is possible only by means of protective regulations and artificial ulture and stocking of juveniles of an adequate ize for survival. (Baker-IVI)
W84-03103

TEMPERATURE PREFERENCE AND AVOIDANCE BY ADULT RAZORBACK SUCKERS,
Utah Cooperative Fishery Research Unit, Logan.
For primary bibliographic entry see Field 5C.
W84-03315

HYDROELECTRIC DEVELOPMENT AND WILDERNESS CONFLICT IN SOUTH-WEST TASMANIA,
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
A. K. Dragun.
Environmental Conservation, Vol. 10, No. 3, p 197-204, 1983. 6 Fig, 5 Tab, 15 Ref.

Descriptors: *Hydroelectric development, *Wilderness, *Tasmania, *Australia, Environmental effects, Dams, Hydroelectric power, Cost analysis, Cost-benefits analysis, Alternative planning.

The hydroelectric developments planned for South-West Tasmania would inundate tracts having major wilderness and archaeological values as well as threaten a much larger area of wilderness. The development of the region is justified by the construction authority, in terms of an expected high rate of electricity demand towards the year 2000. A range of independent demand analyses suggest that the demand for electricity in Tasmania will not approach the Hydro-Electric Commission's expectations. Thus a lag in demand may be identified which should provide time for a rigorous evaluation of the wilderness value of the region together with an appraisal of the alternative electricity-generation options. A cost advantage exists for the favored 'Gordon-below-Franklin' project. The opportunity-cost differential of this project relative to several less-damaging alternatives is slight, at least when the growth in wilderness and electricity demands are considered. The opportunity-cost tradeoff appears quite trivial when current tourist and recreational impacts are accounted for. (Murphy-IVI)
W84-03324

HYDROBIOLOGICAL STUDY OF A HARNESSED RIVER: THE VERDON (ETUDE HYDROBIOLOGIQUE D'UNE RIVIERE AMENAGEE: LE VERDON LES LACS DE BARRAGE ET LES TRONCONS DE COURS D'EAU A DEBIT REGULE),
Direction de l'Equipement, Paris (France). Dept. of Sites, Environment and Information.
A. Gregoire.
Houille Blanche, No. 2, p 105-114, 1983. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Hydrobiology, *Dams, *Verdon River, Dam effects, Chemical properties, physical properties, Population dynamics, Hydraulics, Flow characteristics, Drainage, Trophic level, Ecological effects, Environmental effects.

The impact of five hydroelectric developments on the components of the ecosystem of a trout river (the Verdon) includes the conditions in reservoirs and the ecological problems specific to sections of streams with a regular flow. A study of the physical and chemical parameters of the water and the sediment in reservoirs ascertains the trophic potential of the environment. The follow up of the seasonal trend of the population of organisms corresponding to the main links of the food chain helps determine the trophic level of these reservoirs. The level of significance of the results for forecasting the change in the quality of water in other reservoirs, is assessed by appraising the relation of the five lakes of the Verdon to the French hydro-electric park. Measurement stations determine the respective impact of the dams on all the components of the ecosystem of the Verdon's flow by comparing mesological and biological structures. The most substantial influence is the change in natural hydraulic conditions. There are measures that can limit the nuisance caused by fluctuations in water level, ten yearly drainage, damming and make-up water. (Murphy-IVI)
W84-03360

HYDRO-ELECTRIC GENERATION AND THE ENVIRONMENT (LA PRODUCTION HYDROELECTRIQUE ET L'ENVIRONMENT),
P. Leborgne.
Houille Blanche, No. 2, p 115-118, 1983. 6 Fig.

Descriptors: *Hydroelectric plants, *Environment, Environmental effects, Pollution load, Environmental impact statement, Plant populations, Optimum development plans.

Because of the diversity of hydro-electric installations there is no standard solution to the environmental problem. By reason of the renewable and limited pollutance of the energy they produce the value of these installations has led project contractors to work out various approaches to their optimum environmental harmony. An overview of the impact of hydro-electric developments on the environment is developed by studying plants which may cause nuisances (for which remedies will be found) and plants whose effects are beneficial. There is a considerable tourist attraction to the water tracts created by hydro-electric developments. (Murphy-IVI)
W84-03361

MARINE LOG TRANSPORTATION AND HANDLING SYSTEMS IN BRITISH COLUMBIA: IMPACTS ON COASTAL MANAGEMENT,
Victoria Univ. (British Columbia). Dept. of Geography.
M. C. R. Edgell, and W. M. Ross.
Coastal Zone Management Journal, Vol. 11, No. 1-2, p 41-69, 1983. 4 Fig, 1 Tab, 27 Ref.

Descriptors: *Coastal zone management, *British Columbia, *Forestry, *Log handling, Log transport, Estuaries, Resources management, Lumber industry, Mariculture, Recreation, Fisheries, Harbors.

Over 90% of British Columbia's annual log harvest enters into complex water-based systems of transportation, storage, and handling. These systems have considerable impacts on a wide range of coastal resources and uses. A number of site-specific conflicts have arisen between forestry and pre-existing or emerging values including fisheries, mariculture, recreational boating, and harbor redevelopment. Specific data on the impacts leading to conflict are often fragmentary. However, concerns about highly valued and fragile areas, particularly estuaries, along with industrial concerns regarding log losses and handling efficiency, have prompted changes in log handling. These include moves to dryland sorting, log bundling, and a redistribution of forestry activities in estuaries to accommodate other values. Conflict adjustments and responses have in the past been largely ad hoc and attempted in a jurisdictional vacuum concerning control of coastal management. A more inclusive strategy is now slowly emerging, which involves the coordinated participation of federal, provinicial, and industrial interests. (Author's abstract)
W84-03424

MULTILEVEL WITHDRAWAL AND WATER QUALITY,
Ecole Nationale des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 2H.
W84-03472

ENVIRONMENTAL ASPECTS OF CLEARING AND SNAGGING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
F. D. Shields, Jr., and N. R. Nunnally.
Journal of Environmental Engineering, Vol. 110, No. 1, p 152-165, February, 1984. 2 Fig, 1 Tab, 55 Ref.

Descriptors: *Clearing, *Snagging, *Environmental effects, Flood control, Vegetation, Hydraulic capacity, Detritus, Stream banks, Riparian vegetation.

Clearing and snagging is the removal of woody vegetation and debris from stream channels and banks to increase hydraulic capacity and prevent hazards to navigation or bridges. Clearing and snagging can reducing the frequency and duration of high frequency flooding in environmental sensitive locations. Hydraulic effects of clearing and snagging may be estimated by manipulating the resistance factor in the uniform flow equation. Riparian vegetation and the organic debris it produces influence stream morphology, water quality, and aquatic and terrestrial ecosystems. Complete clearing and snagging has detrimental effects on these stream characteristics; modified clearing and snagging is less damaging to the environment. Major modifications involve: selective removal and disposal of trees and snags based on size, location, condition, and habitat value; labor intensive construction techniques; access controls; and work scheduling to avoid fish spawning or other environmentally sensitive periods. Considerations for planning and design of a selective clearing and snagging project include selection of trees and snags for removal, disposal or utilization of debris, construction equipment and methods, access routes, revegetation, and protection of existing vegetation. Project success is ensured by an interdisciplinary approach, detailed specification, and tight supervision. (Moore-IVI)
W84-03473

COMPARATIVE STUDY OF THE NUTRIENT-SALTS OF LAKE EDKU (EGYPT) BEFORE AND AFTER THE CONSTRUCTION OF ASSWAN'S HIGH DAM IN 1958 AND 1969,
Baden-Wuerttemberg Landesanstalt fuer Umweltschutz (Germany, F.R.).
M. W. Banoub.
Archiv fur Hydrobiologie, Vol. 99, No. 1, p 106-117, December, 1983. 6 Fig, 2 Tab, 7 Ref.

Descriptors: *Dam construction, *Lakes, *Nutrients, Environmental effects, Lake Edku, Egypt, Aswan Dam, Phosphates, Silicates, Acidity.

Comparing the hydrochemical data of Lake Edku in 1958 with those recently published after the construction of the high dam, expressed several changes. The lagoon water-level variations decreased on amplitude and phase where the maximum shifted from summer to winter. Monthly chloride-average of the lagoon reached its maximum in winter in 1969 instead of summer in 1958 indicating the main invasion period by seawater. Phosphates increased from 0.036 to 0.081 mg P/liter between 1958 and 1969. At the same time the P-utilization in the lagoon decreased from 70 to 30%. Silicates decreased from 4.5 to 1.4 mg Si/liter on the average after cessation of the Nile floods. Indications suggesting change in the lagoons macrophytic and hydrophytic production are discussed in relation to the observed changes in water nutrients, pH, alkalinity and the water residence-time. A review of past productivity estimates is discussed in an effort to assess the primary productivity in the lagoon in relation to its past history and its fishery potential. (Baker-IVI)
W84-03504

7. RESOURCES DATA

7B. Data Acquisition

SPECTRAL MEASUREMENTS OF SURFACE SUSPENDED MATTER IN AN OXBOW LAKE IN THE LOWER MISSISSIPPI VALLEY,
Science and Education Administration, Beltsville, MD.
J. C. Ritchie, F. R. Schiebe, and C. M. Cooper.
Journal of Freshwater Ecology, Vol. 2, No. 2, p 175-181, July, 1983. 6 Fig, 3 Ref.

Descriptors: *Spectral analysis, *Oxbow lakes, *Suspended sediments, Lake Chicot, Arkansas, Surface water, Remote sensing.

Lake Chicot is an oxbow lake located adjacent to the west bank levee of the Mississippi River in Chicot County, Arkansas. Spectral reflectance was successfully used in a study of the lake designed to estimate the concentration of suspended solid in the surface water. Wavelengths between 700 and 900 nm gave the best estimate of the concentration of suspended solids. It should be possible to estimate the concentration of suspended solids in the surface water of Lake Chicot using remote sensing technology. Thus Landsat images, aerial photography, or sensors mounted directly over the water surface and transmitting data could give a reservoir manager valuable data about suspended solids concentration that would be useful in making decisions on the management of water inflow to a lake or reservoir to control water quality. (Baker-IVI)
W84-02970

MEASURING THE MARKET FOR WATER INSTRUMENTS,
R. A. Young.
Pollution Engineering, Vol. 15, No. 8, p 30-33, August, 1983. 3 Fig, 5 Tab.

Descriptors: *Measuring instruments, *Monitoring, Water quality control, Wastewater disposal, Wastewater treatment facilities, Water treatment.

A survey was conducted to determine buying patterns related to water quality instrumentation. To get the most out of a pollution control system, it needs process control instrumentation to ensure that it is running at design standards. Such parameters as temperature, flow, level, humidity, pH, and others should be continuously monitored when applicable. One important development in the field has been the recent establishment of an independent testing program. Of greatest concern at the moment in the industry is the control of hazardous and toxic waste materials. (Baker-IVI)
W84-03049

SOIL EROSION IN THE PALOUSE: AN AERIAL PERSPECTIVE,
Agricultural Research Service, Pullman, WA.
For primary bibliographic entry see Field 2J.
W84-03052

THEORETICAL AND MEASURED EVAPORATION RATES FROM AN EXPOSED PICHE ATMOGRAPH,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W84-03213

SEASONAL ESTIMATES OF TRANSPIRATION FROM A MILLET CROP USING A POROMETER,
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 2D.
W84-03214

STATISTICAL ASSESSMENT OF SOME ERRORS IN THERMOCOUPLE HYGROMETRIC WATER POTENTIAL MEASUREMENT,
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
M. J. Savage, A. Class, and J. M. De Jager.
Agricultural Meteorology, Vol. 30, No. 2, p 83-97, 1983. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Measuring instruments, *Water potentials, Hygrometry, Dewpoint, Calibration, Mathematical equations, Model studies.

Thermocouple hygrometers are considered by some workers as the standard for water potential measurements under temperature controlled conditions, but this confidence does not extend to field conditions. A model for calculating some errors in the measurement of water potential for individual thermocouple hygrometers used in the dewpoint or psychrometric mode is based on calculation of the relative standard error in measured thermocouple psychrometric water potential as a function of temperature. The errors were shown to arise from the variability in the determination of the slope (S) and intercept (I) of the psychrometer block temperature (T) verses 1/kT curve, the error in voltage measurement (which includes zero offset and electronic noise errors) and error in temperature measurement. Assuming a zero offset of 0.5 microV and an error in temperature 0.25 degrees C and a measured water potential of -1250 kPa, the total error ranged betwen 15.6 and 5.5% (at 0 and 45 degrees C, respectively) for the worst psychrometer, and between 5.9 and 2.2% for the best. A similar statisical analysis showed that the magnitude of the error in dewpont water potentail was critically dependent on the dewpoint cooling coefficient. It is recommended that all parameters required for the application of the model be known a priori, so that the error value may be determined routinely. (Baker-IVI).
W84-03215

SUPERCOOLED LIQUID WATER AND ICE CRYSTAL DISTRIBUTIONS WITHIN SIERRA NEVADA WINTER STORMS,
Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
For primary bibliographic entry see Field 2B.
W84-03303

AUTOMATED RAIN SAMPLER FOR TRACE ORGANIC SUBSTANCES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W84-03330

INFRARED REMOTE SENSING FOR MONITORING RAINFALL,
EROS Data Center, Sioux Falls, SD.
For primary bibliographic entry see Field 2B.
W84-03455

8. ENGINEERING WORKS

8A. Structures

EVALUATING THE SAFETY AND SEISMIC STABILITY OF EMBANKMENT RESERVOIRS,
Converse Consultants, Inc., Seattle, WA.
D. E. Ryden.
Journal of the American Water Works Association, Vol. 76, No. 1, p 35-39, January, 1984. 3 Fig, 1 Tab, 1 Ref.

Descriptors: *Reservoirs, *Safety, Earthquakes, Seattle, Washington, Earth dams, Embankments, Seismic properties, Stability analysis.

Open storage reservoirs formed by earthen embankments may be classified as facilities with a high seismic hazard potential, especially if the surrounding areas have been heavily developed. A geotechnical evaluation of 12 open embankment reservoirs was undertaken in Seattle, Washington, to determine the safety and seismic stability of the facilities in the event of earthquakes. Most of the reservoirs were constructed from 1901 through 1931 with the oldest being Volunteer Reservoir and the newest being Lake Forest Reservoir (1962). They were typically formed by using a natural topographic swale or slope, escavating into the upper soil levels, and reusing the excavated material to construct an earth embankment 4.5 to 9.1 m high at the lower end of the natural grade. It was recommended that grass be kept trimmed and the brush thinned to permit observation of potential problems such as seepage or slumping. Rodent burrows were noted and it was felt they should be eliminated as their burrow systems could weaken the embankments. Outlet controls should be provided inside the reservoir as well as at the outboard toe of the embankment. Underdrain outlets should be metered to provide a more accurate indication of the quantity of loss through the underdrain systems. A regular periodic inspection program is to be continued. (Baker-IVI)
W84-03139

KEEPING OLD RESERVOIRS ACTIVE,
Portland Bureau of Water Works, OR.
F. Whitfield.
Journal American Water Works Association, Vol. 76, No. 1, p 40-43, January, 1984. 3 Fig.

Descriptors: *Reservoirs, *Maintenance, Portland, Oregon, Open reservoirs, Water storage, Vandalism, Cleaning.

Experience in Portland, Oregon with old open storage reservoirs as well as a variety of covered storage facilities has evolved into a routine cleaning, maintenance, and protective program. Storage of chlorinated water in the open reservoirs in Portland's system requires periodic cleaning to prevent water quality deterioration, and protection of these reservoirs from the public is also important. The Portland Water Board has significantly extended the useful life of the aging facilities with these procedures. These open reservoirs are located in parklike settings. Most are accessible to the public and are about 80 years old. It is the practice in Portland to clean open reservoirs every six months in the spring and fall. Use of hidden cameras guards against vandalism. (Baker-IVI)
W84-03140

RBC BROAD-CRESTED WEIRS FOR CIRCULAR SEWERS AND PIPES,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. J. Clemmens, M. G. Bos, and J. A. Replogle.
Journal of Hydrology, Vol. 68, p 349-368, 1984. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Weirs, Pipes, Sewer systems, Flow, Design criteria.

Existing experience with and theory of long-throated flumes has led to the adaptation of the

RBC Broad-crested weir to flow in circular pipes flowing partly full. The ideal flow equations were solved and the resulting stage-discharge relationship is listed. A mathematical model of flow over broad-crested weirs was used to determine the stage-discharge relationship for actual flow. The results were fit to an empirical equation in non-dimensional form for a wide range of sill heights and pipe sizes. Maximum capacity and head loss requirements for any given weir size are given. Maximum calibration errors result from several sources including: basic calibration, effects of friction not accounted for by Froude modeling, effects of empirical curve fit, and errors in zero setting and depth detection. An example is given which shows how to design these weirs to minimize the effects of the weir on flow conditions in the channel. In many situations, these weirs can be designed to pass a majority of the sediment which moves through the channel. These weris are simple and inexpensive to construct and should be easily adapted to current measurement needs in circular open channels. (Baker-IVI)
W84-03350

8B. Hydraulics

OPERATIONAL FLOOD ROUTING FOR HYDROELECTRIC PLANTS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W84-02993

THE EFFECTS OF CURVATURE IN SUPERCRITICAL SIDE WEIR FLOW,
Sheffield City Polytechnic (England). Dept. of Civil Engineering.
D. J. Balmforth, and E. J. Sarginson.
Journal of Hydraulic Research, Vol. 21, No. 5, p 333-343, 1983. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Curvature, *Supercritical flow, *Weirs, Mathematical models, Side weirs, Water depth, Flow discharge, Channel slope, Critical depth.

A method for analyzing supercritical flow in a channel fitted with a side weir has been developed and tested against experimental data. Results of the experimental program have established the conditions under which supercritical flow occurs along a side weir, and showed that in cases where the flow upstream of the weir is subcritical the drawdown to supercritical flow produces sufficient curvature of the streamlines to affect the vertical pressure distribution. Modification of the differential equation to allow for curvature effects has significantly improved the accuracy of computation of depths and discharges. The depth at the upstream end of the weir is shown to be a function of the upstream critical depth, the weir crest height and the slope of the channel, and the rate of change of surface curvature along the upstream portion of the weir is found to depend on the upstream critical depth. Apart from these relationships little use is made of empirical formulae in analysis, so that the method may be applied to any side weir where supercritical low occurs.
W84-03165

DIFFUSION MODEL FOR DEGRADING CHANNELS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
M. A. Gill.
Journal of Hydraulic Research, Vol. 21, No. 5, p 369-378, 1983. 5 Fig, 8 Ref.

Descriptors: *Channel degradation, *Diffusion, *Mathematical models, Fourier series, Error function, Hydraulic models, Dam effects, Sediments, Channel beds.

Degradation problems below dams and in a channel whose downstream end is suddenly lowered are formulated for rectangular channels of finite length. Two specific cases are considered: degradation of channel beds due to sudden reduction of sediment supply at an upstream location with flow conditions otherwise remaining unaltered in its original steady conditions; and degradation of channel beds induced by abrupt lowering of bed level at the downstream end. The first of these situations frequently occurs downstream of dams. The proposed analytical solutions cover the complete range of transient phase terminating in the final steady flow regime. Two types of solutions are obtained. The Fourier series solutions is best suited for computations at large values of time and the error function solution at small values of time. (Moore-IVI)
W84-03166

FLOOD ROUTING THROUGH A FLAT, COMPLEX FLOODPLAIN USING A ONE-DIMENSIONAL UNSTEADY FLOW COMPUTER PROGRAM,
Hydrologic Engineering Center, Davis, CA.
J. C. Peters.
Water Resources Bulletin, Vol. 19, No. 6, p 913-920, December, 1983. 9 Fig, 4 Ref.

Descriptors: *Flood routing, *Floodplains, *Unsteady flow, *Computer models, Flood data, Hydrographs, Flood hydrographs, Model studies, Simulation, Flood waves, Passaic River, New Jersey.

The routing of flood waves through the Central Basin of the Passaic River in New Jersey is complex because of flat gradients and flow reversals. The one-dimensional unsteady flow program DWOPER simulates flood wave movement through the Basin. A historical event was used for calibration, and two synthetic events were simulated. Boundary conditions consisted of discharge hydrographs at inflow points to the study area, local flow hydrographs at interior points, and a stage discharge relation for flow over the crest of a diversion dam at the basin outlet. Manning's values were adjusted based on stage and discharge data for the historical event. Verification data were not available for events comparable in magnitude to the synthetic events. Included are techniques for characterizing the flow system, model calibration, techniques for representing a tunnel diversion, and simulation results. (Murphy-IVI)
W84-03395

EXTREMAL HYPOTHESES FOR RIVER REGIME: AN ILLUSION OF PROGRESS,
G. A. Griffiths.
Water Resources Research, Vol. 20, No. 1, p 113-118, January, 1984. 1 Fig, 34 Ref.

Descriptors: *Channel stability, *Alluvial channels, *Mathematical equations, Sediment transport, River regimes, Flow resistance, Sediment discharge.

The extremal hypotheses of minimum stream power, minimum unit stream power, minimum energy dissipation rate, and maximum sediment transport rate, when combined with conventional sediment transport and flow resistance equations, lead to conclusions incompatible with observations. For wide, straight, unconstrained alluvial reaches in equilibrium, these conclusions include that the Einstein sediment discharge and Shields entrainment function are nearly constant, the magnitude of the particular constants depending only on the hypothesis and equations used, whereas data from flumes and natural rivers show that both expressions are highly variable in stable channels. Constancy of the Einstein and Shields expressions provides, in fact, a sufficient but unnecessary condition for channel stability. In the maximum friction factor hypothesis there is no maximum for friction factor when channel width, depth, and slope are dependent variables. Variational principles may one day supply a solution to the problem of alluvial channel stability, but current formulations of the mentioned hypotheses require redefinition. (Author's abstract)
W84-03417

8D. Soil Mechanics

RECENT DEVELOPMENTS ON THE PROBABLE MAXIMUM PRECIPITATION (PMP) ESTIMATION IN CHINA,
East China Technical Univ. of Water Resources, Nanjing. Dept. of Hydrology.
For primary bibliographic entry see Field 2B.
W84-03347

SENSITIVITY OF OUTFLOW PEAKS AND FLOOD STAGES TO THE SELECTION OF DAM BREACH PARAMETERS AND SIMULATION MODELS,
Illinois State Water Survey Div., Champaign.
K. P. Singh, and A. Snorrason.
Journal of Hydrology, Vol. 68, p 295-310, 1984. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Dam failure, *Design criteria, *Flood control, Floods, Dams, Earth dams, Model studies, Channels, Dam construction.

A detailed study of historical earthdam failures due to overtopping was reviewed to identify important breach parameters. Various combinations of breach parameters (failure time, depth of overtopping, and breach size) were used for breach simulations in both the US Army Corps of Engineers Hydrologic Engineering Center model and the National Weather Service model. In general, the flood stage profiles predicted by the NWS were smoother and more reasonable than those pedicted by the HEC. For channels with relatively steep slopes, the methods compared fairly well, whereas for the channels with mild slope, the HEC model often predicted oscillating, erratic flood stages, mainly due to inability to route flood waves satisfactorily in non-prismatic channels. The breach outflow peaks are affected significantly by the breach size but less so by the depth of overtopping. The ratio of outflow peak to inflow peak and the effect of failure time on outflow decrease as the drainage area above the dam and impounded storage increase. Flood stage profiles predicted with cross-sections taken from 7.5 foot maps compared favorably with those predicted using surveyed cross-sections. For the range of breach parameters studied, the range of outflow peaks and flood stages downstream from the dam can be determined for regulatory and disaster prevention measures. (Baker-IVI)
W84-03348

8E. Rock Mechanics and Geology

EROSIONAL UNLOADING AND FLUID PRESSURES IN HYDRAULICALLY 'TIGHT' ROCKS,
Geological Survey, Reston, VA.
C. E. Neuzil, and D. W. Pollock.
Journal of Geology, Vol. 91, No. 2, p 179-193, 1983. 7 Fig, 35 Ref.

Descriptors: *Erosion, *Fluid pressures, *Rock properties, Rock mechanics, Hydraulic permeability, Hydraulic friction, Pore pressure, Mathematical analysis, Hydrodynamics.

When rocks deform in response to changes in stress, the small variations in pore volume that occur affect the pore fluid pressure. The changes in fluid pressure can be significant if the rate of change of stress is large relative to the rate at which pressure perturbations are dissipated by flow. It has been proposed previously that the gradually increasing loads on sediments undergoing burial can cause excess fluid pressures. We hypothesize that the opposite effect, depression of pore pressure resulting from rebound during erosional unloading, also may occur in certain geologic settings. Simple theoretical treatment of the problem indicates that rocks with small hydraulic diffusivity, such as some shales, could experience significant pore pressure decreases when unloaded by moderate rates of erosion. The analysis further indicates that decreases sufficient to produce nega-

tive pressures can occur. No theoretical bar to this condition exists, and it has been achieved in the laboratory. However, in subsurface environments, it is perhaps more likely that degassing of the pore fluid and resulting increase of gas volume, or desaturation, would occur. Thus it appears that a mechanism exists for generating significant underpressuring and unsaturated conditions below the water table in thick sequences of poorly permeable rock. The analysis also shows that in formations with depressed fluid pressures the groundwater flow is inward from the permeable boundaries for long periods of time. These results may be of importance if toxic materials are to be isolated in 'tight' rocks. (Author's abstract)
W84-03236

A STOCHASTIC MODEL OF A FRACTURED ROCK CONDITIONED BY MEASURED INFORMATION,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering.
J. Andersson, A. M. Shapiro, and J. Bear.
Water Resources Research, Vol. 20, No. 1, p 79-88, January, 1984. 8 Fig, 3 Tab, 20 Ref, 1 Append.

Descriptors: *Geologic fractures, *Stochastic process, *Model studies, *Rock properties, Cores, Groundwater movement, Statistical models.

A method for the modeling of a fractured rock is developed which takes into account the uncertainty in the fracture network geometry as well as actually measured information, such as that obtained from cores. Based on certain simplifying assumptions, of which the most important are planar and independent fractures, a stochastic a priori model is formulated. The real fracture network is assumed to be a realization of this a priori model. Since measurements are performed on the real network, two different kinds of information are made available. The first kind is of deterministic nature and expresses the actual location of intercepted fractures; by inference the other part is probabilistic, given as the probability of observing a fracture intersecting the model region. This observation probability is shown to depend on the a priori model, on the geometry of the region and on the measurements only. A conditional model is formulated where each realization consists of the actually observed fractures and an additional number of stochastically generated fractures obtained by employing the probabilistic information. The number of stochastically generated fractures is a stochastic variable, the distribution of which depends on the number of fractures observed and the observation probability. Even if the rock is penetrated with only a few cores, it is possible to quantify the statistics of properties, such as the total leakage into a tunnel or the concentration of pollutants close to a waste repository. By increasing the number of cores, the uncertainty in these values is reduced. The amount of uncertainty reduction can be quantified by applying the model of the investigated domain taking into account the information from the additional measurements. As a demonstration, the proposed model is applied to a simple problem of steady state two-dimensional flow in a vertical plane. It appears that the technique presented may serve as a powerful tool for quantifying uncertainties in flow problems and in providing guidance on how to acquire additional information of the fractured network in a given domain of fractured rock. (Author's abstract)
W84-03414

8I. Fisheries Engineering

INFLUENCE OF DEGREE OF STREAM TURBULENCE ON THE MAGNITUDE OF THE CRITICAL CURRENT VELOCITY FOR FISH,
Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
D. S. Pavlov, M. A. Skorobogatov, and L. G. Shtaf.
Doklady Biological Sciences, Vol. 267, No. 1-6, p 560-562, November-December, 1982. 2 Fig, 5 Ref. Translated from Doklady Akademii Nauk SSSR, Vol. 267, No. 4, p 1019-1021, December, 1982.

Descriptors: *Fish behavior, *Turbulence, Streams, Fish, Fisheries, Fish management.

One of the most important characteristics of a stream is the degree of its turbulence. In fish motion the critical current velocity equals the minimum current velocity that exhausts a fish. In order to increase the range of change in the turbulence intensity in the stream, a system of races was created above the upper net with the help of submerged hydraulic spring, acting as a generato of elevated turbulence. Young roach were used i the study. A stream with a higher degree of turbu lence possesses a greater kinetic energy for fis Therefore, the energy expenditures of fish will b higher in such currents, leading to a decline in th critical velocity. The findings should be taken int account in the control of fish behavior. An i crease in the degree of turbulence in active fishin equipment, such as a trawler, will promote th most rapid exhaustion of the fish and an increase the catch. At the same time an increased strea turbulence in the fish tanks of fish-passing struc tures is undesirable as it will result in the loss o fish to the current. (Baker-IVI)
W84-03027

HYDRAULIC CHARACTERISTICS OF TH CURRENT THAT PRODUCES ROUTES FO FISH MOVEMENT,
Akademiya Nauk SSSR, Moscow. Nauchnyi Sove po Neorganischeskoi Khimii.
D. S. Pavlov, A. Sh. Barekyan, M. A. Skorobogatov, and L. G. Shtaf.
Doklady Biological Sciences, Vo. 270, No. 1-6, 230-233, May-June, 1983. 2 Fig, 5 Ref. Translate from Doklady Akademii Nauk SSSR, Vol. 27 No. 6, p 1513-1516, June, 1983.

Descriptors: *Fish behavior, *Water current *Dams, Powerplants, Hydraulic structure Spawning, Fish, Uglichskow Reservoir.

A model hydrosystem with a fish passing structur arranged along the axis of the spillway front wa set up in a hydraulic tank of 6.5 m length and 1.2 width. Various hydraulic regimes were created i the lower water race of the model with the help o the gates of the model itself. The current depth i the lower water race of the hydrosystem com prised 0.08 m. Current hydraulic characteristic seen to be involved in the production of routes o fish movement in a current included the longitud nal velocity component, the turbulence intensity and the transverse gradient. The data obtained wa used to develop a method for predicting the en trance of fish into fish-passing structures. (Bake IVI)
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VOLUME 17, NUMBER 10
OCTOBER 1984

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AT URBANA-CHAMPAIGN

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 17, NUMBER 10
OCTOBER 1984

W84-03505 -- W84-04187

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

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leaching from strip-mined lands would facilitate the development of sound management practices by allowing assessment of each technique for any given condition to be made in minutes rather than years. A model describing the long-term oxidation of pyrite and the removal of reaction products from reclaimed coal strip mines using both direct-oxygen and ferric iron oxidation of pyrite is considered. The pyrite oxidation rate is assumed to be controlled by first-order, solid-liquid kinetics and the rate of simple diffusion of oxidant into reactive, coarse, stone fragments. The oxygen supply into the reclaimed profile is considered to be governed by one-dimensional gas diffusion. Ferric iron is produced by both purely chemical and bacterial oxidation of ferrous iron. Activity of the iron-oxidizing bacteria is controlled by the energy available from ferrous oxidation, as measured by the ferric/ferrous ratio, and from a combination of potentially inhibiting factors: the oxygen concentration in the spoil air, the hydrogen ion concentration in solution, and the soil temperature. Bacterial activity and pyrite oxidation are linked through a shared environment. The side reactions considered include the complexation and precipitation of ferric iron and the interaction between hydrogen ion in solution and the spoil matrix. Soluble reaction products are removed from the reclaimed profile by percolating water. (Murphy-IVI)
W84-03820

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 2. SIMULATION RESULTS OF MODEL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
D. B. Jaynes, H. B. Pionke, and A. S. Rogowski.
Water Resources Research, Vol. 20, No. 2, p 243-250, February, 1984. 11 Fig, 3 Tab, 6 Ref.

Descriptors: *Acid mine drainage, *Strip mines, *Simulation analysis, Model studies, Mathematical studies, Pyrite, Oxidation, Oxygen balance, Hydrogen ion concentration.

Acid mine drainage from reclaimed coal strip mines is simulated by use of a comprehensive model. The simulated concentrations of key components are well within the ranges of measured values from reclaimed mines. In systems without iron-oxidizing bacteria the simulations indicate that oxygen is the only important oxidizer of pyrite. The oxidation of ferrous to ferric iron by purely chemical means is too slow to affect the overall oxidation rate of pyrite and is not important in these systems. For the typical physical parameters used here the diffusion rate of oxygen is the primary factor controlling the rate of pyrite oxidation. The pyrite oxidation rate is decreased by decreased air-filled porosity, by increased tortuosity of the oxygen diffusion path, by increased size of the spoil fragments, and by burying the pyritic material at deeper depths. Where oxygen resupply is not limiting the results indicate that iron-oxidizing bacteria can greatly increase the rate of pyrite oxidation. Whether or not bacteria are important in these zones depends primarily on the pH of the spoil solution. In the optimal pH range, between reduced bacterial efficiency and reduced ferric iron solubility ($2.0 < \text{or} = \text{pH} < \text{or} = 3.0$), the pyrite oxidation rate is accelerated by bacterially produced ferric iron. The extent and type of chemical reactions between H(+), produced by pyrite oxidation, and the spoil matrix appears to be crucial in establishing the pH of the spoil solution. (Murphy-IVI)
W84-03821

PROBLEM OF PERMISSIBLE COVARIANCE AND VARIOGRAM MODELS,
Ecole Nationale Superieure des Mines de Paris (France). Centre de Geostatistique et de Morphologie Mathematique.
G. Christakos.
Water Resources Research, Vol. 20, No. 2, p 251-265, February, 1984. 5 Fig, 33 Ref.

Descriptors: *Permissible Covariance, *Variogram models, Mathematical models, Hydrologic models, Geostatistics, Polygonal models.

The covariance and variogram models (ordinary or generalized) are important statistical tools used in various estimation and simulation techniques which have been recently applied to diverse hydrologic problems. For example, the efficacy of kriging, a method for interpolating, filtering, or averaging spatial phenomena, depends, to a large extent, on the covariance or variogram model chosen. The aim of this article is to provide the users of these techniques with convenient criteria that may help them to judge whether a function which arises in a particular problem, and is not included among the known covariance or variogram models, is permissible as such a model. This is done by investigating the properties of the candidate model in both the space and frequency domains. This investigation covers stationary random functions as well as intrinsic random functions (i.e., nonstationary functions for which increments of some order are stationary). Then, based on the theoretical results obtained, a procedure is outlined and successfully applied to a number of candidate models. In order to give this procedure a more practical context, 'stereological' equations are employed that essentially transfer the investigations to one-dimensional space, together with approximations in terms of polygonal functions and Fourier-Bessel series expansions. There are many benefits and applications of such a procedure. Polygonal models can be fit arbitrarily closely to the data. Also, the approximation of a particular model in the frequency domain by a Fourier-Bessel series expansion can be very effective. (Murphy-IVI)
W84-03822

NONLINEAR STOCHASTIC MODEL OF RAINFALL RUNOFF PROCESS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. G. Rao, and R. A. Rao.
Water Resources Research, Vol. 20, No. 2, p 297-309, February, 1984. 7 Fig, 7 Tab, 18 Ref. OWRT project C-3277.

Descriptors: *Nonlinear stochastic models, *Rainfall-runoff relationships, Rainfall, Runoff, Forecasting, Rough River, Kentucky.

A nonlinear stochastic model is proposed to model the rainfall runoff process in which higher order derivatives of rainfall are used in addition to the magnitude of rainfall as inputs. The rainfall, runoff, and derivatives of rainfall are considered as stochastic. The model consists of several subsystems in parallel. The first subsystem utilizes the observed rainfall and runoff as input and output, respectively. The subsequent subsystems use higher order derivatives of rainfall as input and forecast error from the previous subsystems as output. The subsystems improve the performance of the overall model by using higher order derivatives of input. The error in forecasting the runoff is progressively reduced by each subsystem. The method of analysis and parameter estimation of each of the subsystems are the same except that different inputs and outputs are used to characterize the subsystems. The optimal output of each of the subsystems is computed by minimizing the corresponding mean square error, and the estimation procedure is based on the statistical theory of filters involving the marginal and joint probability density functions of rainfall, runoff, and rainfall derivative sequences. The model is tested using daily rainfall runoff data from the Rough River basin in Kentucky. Testing the residuals of the model for whiteness is emphasized in order to improve the prediction performance of the model. (Murphy-IVI)
W84-03826

RAINFALL-RUNOFF IN SOIL EROSION WITH SIMULATED RAINFALL, OVERLAND FLOW AND COVER,
M. J. Singer, and P. H. Walker.
Australian Journal of Marine and Freshwater Research, Vol. 21, No. 2, p 109-22, 1983. 3 Fig, 6 Tab, 26 Ref.

Descriptors: *Rainfall-runoff relationships, *Soil erosion, *Simulated rainfall, *Overland flow, Straw cover, Agricultural runoff, Surface runoff, Rainfall impact, Rainfall intensity, Sheet erosion.

The relative importance of rainsplash, rain-flow transportation and overland flow alone in sheet erosion may be determined by using a flume and rainfall simulator with soil materials. The 20-100 mm portion of a yellow podzolic soil (Albaqualf) from the Ginninderra Experiment Station (A.C.T.) was used in a rainfall simulator and flume facility to elucidate the interactions between raindrop impact, overland water flow and straw cover as they affect soil erosion. A replicated factorial design compared soil loss in splash and runoff from 50 and 100 mm/h rainfall, the equivalent of 100 mm/h overland flow, and 50 and 100 mm/h rainfall plus the equivalent of 100 mm/h flow, all at 0, 40 and 80% straw cover on a 9% slope. As rainfall intensity increased, soil loss in splash and runoff increased. Within cover levels, the effect of added overland flow was to decrease splash but to increase total soil loss. This is due to an interaction between raindrops and runoff which produces a powerful detaching and transporting mechanism within the flow known as rain-flow transportation. Airsplash is reduced, in part, because of the changes in splash characteristics which accompany changes in depth of runoff water. Rain-flow transportation accounted for at least 64% of soil transport in the experiment and airsplash accounted for no more than 25% of soil transport. The effects of rainfall, overland flow and cover treatments, rather than being additives, were found to correlate with a natural log transform of the soil loss data. The findings have relevance to predictive models such as CREAMS which are based on erosional processes. (Murphy-IVI)
W84-03875

SMEMAX. CAUTION,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
J. A. Westphal.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 209-218, March, 1984. 5 Tab, 7 Ref.

Descriptors: *SMEMAX, Model studies, Computer programs, Mathematical equations, Mathematical models, Mathematical studies, Flood data, Flood hydrographs, Comparison studies, Flood frequency.

The intrinsic appeal of SMEMAX is that it seems to obviate the need for choosing a 'best fit' distribution from among several possible options. The SMEMAX Transformation was tested on samples generated from log-Pearson Type III and Gumbel Extreme Value Type 1 distributions. Although the transformation results in a distribution with a skew near zero, it is not a true normal distribution. The coefficients of kurtosis for the transformed distributions are always less than three and when the parent distribution approaches a reverse-J shape, the transformed distribution is bimodal. When the skew coefficient of the logarithms of events is -0.5 or greater for samples from the log-Pearson Type III distribution, the SMEMAX procedure underestimates the magnitude of events with return periods of 50 yr and greater. Similarly, SMEMAX estimates of rare events from the Gumbel Extreme Value Type 1 distribution are always too low. Based on comparisons made in this study, it is likely that application of SMEMAX procedures to any skewed distribution will result in biased estimates of the magnitude of rate events and if the skew is positive the estimates will be too low. (Murphy-IVI)
W84-03916

SCS URBAN PEAK FLOW METHODS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, W. J. Rawls, and S. L. Wong.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 290-299, March, 1984. 2 Fig, 4 Tab, 8 Ref.

Descriptors: *Hydrologic models, *Flood peak, Flood basins, Flood recurrence interval, Flood forecasting, Flood frequency, Maximum probable floods, Flood hydrographs, Flood plain management, Urban watersheds, Urban hydrology, Urban areas.

The peak flow hydrologic methods of the U.S. Soil Conservation Service (SCS) (as contained in their Technical Release No. 55) are widely used for planning and design on small urban watersheds. The urbanization factors of the TR-55 methods (i.e., the lag factors for the graphical method and the peak factors for the chart method) were apparently not directly based on analyses of measured data and have not previously been systematically tested. Therefore, the objective of this study was to test the TR-55 methods and recalibrate the urbanization factors if the methods were found to be biased. A data base was compiled for 51 small urban watersheds under 4,000 acres (1,600 ha) in the United States. The annual maximum flood series were used to develop Log-Pearson Type III frequency curves, from which peak discharge rates were estimated for the following return periods: 2-yr, 5-yr, 10-yr, 25-yr, 50-yr, and 100-yr. The bias and accuracy of the SCS methods were evaluated using the Log-Pearson Type III estimate as the expected true value. The results indicate that no urbanization correction factors are needed for the graphical methods when time of concentration is determined using the velocity method. The adjustment factor for the hydraulic length modification of the channel only, and the hydraulic length modification adjustment relationship is not a function of curve number. The curve for a curve number of 90 provides the most accurate prediction. (Murphy-IVI)
W84-03921

COLUMBIA RIVER HYBRID MODELING SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Estuaries Div.
W. H. McAnally, Jr., J. V. Letter, Jr., J. P. Stewart, W. A. Thomas, and N. J. Brogdon, Jr.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 300-311, March, 1984. 3 Fig, 13 Ref.

Descriptors: *Columbia River, *Model studies, Mathematical models, Shoals, Sedimentation, Sediment control, Sediment transport, Forecasting, Hydrologic models, Oregon.

The Army Corps of Engineers maintains a 48-ft deep by 2,600-ft wide navigation channel through the estuary entrance of the Columbia River, Oregon, which is protected by jetties. Annual maintenance dredging of 4,800,000 cu yd in the entrance has led the Army Engineer District, Portland (NPP), to seek means of reducing shoaling in the entrance channel. A hybrid modeling method for predicting waterway sedimentation was developed and applied to the Columbia River estuary. The method uses physical hydraulic models, two dimensional (2-D) numerical models, and analytical techniques in an integrated solution scheme. The hybrid modeling system consisted of a large physical model of the estuary, RMA-2V, a depth-integrated numerical model for sediment transport, and a collection of analytical methods. By using each method to address those phenomena that it is best able to describe, an improved modeling technique is created. (Murphy-IVI)
W84-03922

COMPLEX POLYNOMIAL APPROXIMATION OF THE LAPLACE EQUATION,
California Univ., Irvine. Dept. of Civil Engineering.
T. V. Hromadka, II, and G. L. Guymon.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 329-339, March, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *LaPlace Equation, *Mathematical equations, *Polynomials, Surface flow, Porous media, Groundwater, Hydrologic model, Boundary conditions, Freezing, Frozen ground, Soil-water freezing.

A method of approximating the solution of the LaPlace equation in two-dimensions is presented. The numerical approach is to determine a complex variable polynomial which satisfies the specified boundary conditions along a simple closed contour. Since the method is simple to apply to time-stepped, quasi-steady state saturated ground water problems or moving boundary problems, a significant savings in computational effort over other boundary integral equation methods is available. Applications to a free water surface problem and a moving boundary problem are presented. Error bounds and model stability are considered. (Author's abstract)
W84-03924

GENERALIZED MODEL FOR STORMWATER RUNOFF HYDROGRAPHS,
New Jersey Agricultural Experiment Station, New Brunswick.
C. G. Uchrin, and W. J. Weber, Jr.
Journal of Environmental Science and Health, Vol. A19, No. 1, p 67-82, 1984. 7 Fig, 5 Tab, 4 Ref.

Descriptors: *Model studies, *Runoff, *Hydrographs, Storms, Rainfall-runoff relationships, Drainage basins, Rainfall distribution, Michigan.

The most direct method for obtaining detailed stormwater runoff quantity and quality for specific drainage areas is by direct sampling and analysis, but this is often impossible to perform this for all inputs to a receiving water body. An empirical model is presented for generating runoff hydrographs for nationwide drainage basins as a function of the drainage area, population density, and rainfall excess distribution. A computer program was written incorporating the analysis. The model was applied to a study area in southeastern Michigan. A water quality model was constructed for the Huron River-Ford Lake-Belleville Lake system. Detailed sampling and analysis of each storm drain input source was unfeasible, so the runoff quantity model described was used in conjunction with a separate quality submodel to generate time variable pollutant loadings. (Baker-IVI)
W84-03954

PREDICTIVE AGGREGATION MODELS IN HYDROLOGY,
Technical Univ. of Istanbul (Turkey).
Z. Sen.
Nordic Hydrology, Vol. 14, No. 1, p 19-32, 1983. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Model studies, *Hydrologic models, Prediction, Stochastic processes, Rainfall-runoff relationships, Flow.

A predictive aggregation model with recursive parameter estimations has been proposed. Necessary estimation formulations have been explicitly derived and then applied to monthly flows. The estimation procedure does not impose any restrictions concerning either the parameter matrices such as positive semidefiniteness or the standardization of observations to have zero mean. The estimations are unbiased and have the minimum variance as properties of the Kalman filter. The overall advantages of the model are that the computations are based on simple matrix algebra, that there is no need for an inverse matrix operation provided that the measurement matrix is scalar, that the parameters and states are estimated online as the data becomes available, that there is no need to preserve all the data in the computer memory, and that computations can be performed in a short time. Lower-order events can be generated which add up the the given higher-order events without any external intervention. (Baker-IVI)
W84-03973

KALMAN FILTER EMPIRICAL FITTING ON MONTHLY RAINFALL-RUNOFF RESPONSES,
National Technical Univ., Athens (Greece).
M. Mimikou.
Nordic Hydrology, Vol. 14, No. 2, p 93-112, 1983. 8 Fig, 4 Tab, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Kalman filters, Statistical methods, Model studies, Prediction, Runoff, River basins, Rivers, Greece, Aliakmon River, Acheloos River, Snowfall.

The majority of the methods for fitting rainfall-runoff Kalman filters use the statistical characteristics of the input (rainfall) and the output (runoff) series according to the systems analysis and control theory methodology. The presented empirical method of fitting takes into account additional input information and improves the knowledge about the hydrological system, without changing the simple two-variable structure of the filter. This information consists of the percentage of snowfall into the monthly basin rainfall, the magnitude of basin rainfall at month t in comparison to the rainfall at month t-1 (increasing, constant, or decreasing) and the amount of basin rainfall associated with basin's moisture and runoff characterisics. The Kalman filter empirically fitted on monthly rainfall-runoff responses of the Alaikmon and Acheloos river basins in Greece is shown to be more accurate and adequate than the automatically fitted filter by using conventional statistical methods. The filter has been used in hydroelectric energy studies of the area, where accurate runoff estimation from rainfall was necessary. (Baker-IVI)
W84-03980

COMPUTER CONTROL FOR IRRIGATION-CANAL SYSTEM,
Stone and Webster Engineering Corp., Denver, CO.
D. D. Zimbelman, and D. D. Bedworth.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 43-59, March, 1983. 10 Fig, 1 Tab, 16 Ref.

Descriptors: *Irrigation canals, *Computer models, Computers, Algorithms, Water conveyance, Open-channel flow, Water distribution, Comparison studies.

The objective was to develop an algorithm for the computerized control of an open-channel water distribution system that would allow the system to be operated on a demand basis rather than on a scheduled basis. The algorithm, which was of necessity empirical, is an adaption of proportional downstream control. The input to algorithm is the water surface upstream of each control structure. The output from the algorithm is an adjustment in gate opening, implemented at the adjacent upstream control structure. The adequacy of the algorithm was verified by simulating the interaction between the algorithm and two different typical canal systems. These simulations were used to first establish viability of the algorithm in an automated control environment, and secondly to compare automated control to manual control. The control algorithm is capable of controlling an open-channel water distribution system at a higher level of efficiency than manual control. Efficiency, under manual control, is measured in terms of the stability of the water surface elevations within the system. (Murphy-IVI)
W84-04037

PRECIPITATION AND RUNOFF ON EIGHT NEW ENGLAND BASINS DURING EXTREME WET AND DRY PERIODS,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
R. J. Deangelis, J. B. Urban, W. J. Gburek, and M. A. Contino.
Hydrological Sciences Journal, Vol. 29, No. 1, 1984. 7 Fig, 4 Tab, 23 Ref.

Descriptors: *Precipitation, *Rainfall-runoff relationships, New England, Runoff, Seasonal variations, Watersheds, Evapotranspiration, Sleepers River Watershed, Vermont.

Extreme wet and dry 12 month periods occurred during the 20 years of hydrological data collections made at the Sleepers River Watershed (Vermont). Extrapolation of a nearby 87-year precipitation record to the basin was useful in determining the deviations of those extreme periods from normal. Seasonal water-input and runoff increased with elevation for both the wet and the dry period. For both water-input and runoff, the rate of increase was greater during the wet period. The slope of the water-input and runoff regression lines is related to the magnitude of the water-input. Variations in the measured flow at the eight subbasins examined were due to the complex basin and climatological conditions typical of New England

basins. However, the variations may be adequately described using elevation alone as the index. The fact that the increase in summer precipitation with elevation was significantly greater than the increase in runoff suggests that evapotranspiration increased with elevation. The greater magnitude of precipitation at higher elevations results in more potential and thus more actual evapotranspiration. (Baker-IVI)
W84-04067

WATER, SEDIMENT AND NUTRIENT MOVEMENT IN FORESTED AND NON-FORESTED CATCHMENTS IN KUMAUN HIMALAYA,
Kumaun Univ., Naini Tal (India). Dept. of Botany.
A. N. Pandey, P. C. Pathak, and J. S. Singh.
Forest Ecology and Management, Vol. 7, No. 1, p 19-29, November, 1983. 6 Tab, 16 Ref.

Descriptors: *Forest soils, *Overland flow, *Soil loss, *Nutrients, *Himalaya, Soil deposition, Landslides, Cultivation, Monsoons, Vegetation, Storm seepage, Calcium, Potassium, Phosphorus, Nitrogen.

Overland flow, and soil and nutrient loss were assessed for four sites under original forest cover, and for four sites affected by soil deposition, landslide or cultivation in the Kumaun Himalaya during the 1981 and 1982 monsoon seasons. Overland flow was positively related with rainfall quantity and intensity and was reduced by the growth of ground vegetation during the later months of the monsoon season. Average overland flow was only 0.50% of the total incident rainfall indicating that these catchments are subsurface flow systems. Soil loss was positively related with overland flow, both being greater for non-forested compared to forested sites. Rainfall added a significant amount of nutrients. This extra system input was greater than loss through overland flow and runoff soil. The forested sites lost less nutrients compared to non-forested sites. The loss of nutrients was in the order: Ca > K > P > N. The forests of the catchments in Himalaya should be protected to avoid the impairment of hydrologic processes. (Author's abstract)
W84-04128

EFFICIENT AND ROBUST METHOD FOR ESTIMATING UNIT HYDROGRAPH ORDINATES,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
M. Bruen, and J. C. I. Dooge.
Journal of Hydrology, Vol. 70, No. 1-4, p 1-24, 1984. 11 Fig, 19 Ref, 2 Append.

Descriptors: *Unit hydrographs, *Smoothed least squares, Mathematical studies, Flood hydrographs, Matrix structure, Computers, Hydrographs.

The coefficient matrix for the 'normal equations' for least-squares estimates of discrete unit hydrographs (DUH) is symmetric Toeplitz. Smoothed least squares is an effective way of combating the instability of DUH estimates due to numerical ill-conditioning. This matrix structure can be used to reduce both the data storage and arithmetic computation requirements of computer programs for estimating DUHs. The method is particularly useful for small computers when memory space is limited or when large amounts of data are involved. The algorithm can be used to provide smoothed least-squares estimates of the DUH using a single extra arithmetic addition. Estimates of DUH's for multiple-event data can easily be calculated. This method gives the user a degree of control over the estimation process which allows the exercise of subjective judgement. Computer programs are presented for both the single-event and multiple-event case. The utility of the smoothed estimates is illustrated using real data which would give unrealistic ordinary least-squares estimates. The data are for three separate flood events in the Almond and Almondell, Scotland catchment. The catchment has an area of 229 sq km. (Moore-IVI)
W84-04140

STATISTICAL ANALYSIS OF WEATHER-TYPE RUNOFF PHENOMENA IN AN ALPINE ENVIRONMENT,
Vrije Univ., Amsterdam (Netherlands). Inst. of Earth Sciences.
A. A. Van de Griend, and E. Seyhan.
Journal of Hydrology, Vol. 70, No. 1-4, p 51-69, 1984. 11 Fig, 2 Tab, 11 Ref.

Descriptors: *Alpine regions, *Weather, *Runoff, *River Ahr, *Italy, Precipitation, Temperature, Snowmelt, Glaciers, Temporal distribution, Atmospheric circulation, Autocorrelation.

Each class of weather types has its own characteristic population of daily runoff data and sequences of daily runoff. In order to obtain a better insight into the combined effect of weather types working on the complex hydrologic system, several aspects of runoff were analyzed with respect to the distribution of daily runoff occurrences and their time sequence. For this purpose, atmospheric circulation types were classified into hydrologically relevant classes of weather types using a classification developed for the European Alpine region. Hydrologic and meteorological data from the 23-yr period 1953-1975 for the Alpine pluvio-nivo-glacial catchment of the River Ahr (Italy) were used for the analyses. Antecedent hydrologic conditions are subject to large year-to-year changes, especially during the months with snow- and glacier-melt. The magnitude of runoff during each particular class of weather types is largely governed by autocorrelation (related to the characteristic times of the systems active during preceding classes and thus related to the preceding weather types) and by antecedent conditions, rather than by the weather types themselves. The influence of a weather class displays a distinct dependency of the time elapsed since the start of the particular class. On the average, the influence does not become manifest until after a 2-3 day period. (Moore-IVI)
W84-04142

2B. Precipitation

NEW TECHNIQUE FOR THE ANALYSIS OF EXTREME RAINFALL WITH APPLICATION TO LAGOS METROPOLIS, NIGERIA,
Lagos Univ. (Nigeria). Faculty of Engineering.
E. S. Oyegoke, and J. O. Sonuga.
Nordic Hydrology, Vol. 14, No. 3, p 127-138, 1983. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Rainfall, *Storm runoff, *Statistical analysis, *Lagos, *Nigeria, Storms, Entropy, Urban areas, Simulation.

A case study is made of storm rainfall analysis for Lagos metropolis using the available rainfall data for Ikeja, Oshodi and Lagos Mainland. The principle of maximum entropy is viewed as an alternative technique for the parameter estimation of the Extreme Value Type-1 (EV1) distribution or Gumbel distribution often used for the analysis and forecast of extreme events. For comparison purposes, the parameters of the EV1 distribution are also obtained using the Maximum Likelihood Method, the latter being one of the most reliable techniques and perhaps the most widely used for parameter estimation of the EV1 distribution. This exercise makes it possible to demonstrate in some ways the superiority of the maximum entropy method over existing methods used for statistical simulation of extreme events. (Baker-IVI)
W84-03982

REGIONAL RAINFALL CHEMISTRY IN MINNESOTA AND WEST CENTRAL WISCONSIN,
Minnesota Univ., St. Paul. Dept. of Plant Pathology.
G. C. Pratt, M. R. Coscio, and S. V. Krupa.
Atmospheric Environment, Vol. 18, No. 1, p 173-182, 1984. 3 Fig, 5 Tab, 32 Ref.

Descriptors: *Rainfall, *Water pollution effects, *Minnesota, *Wisconsin, *Water chemistry, *Acid rain, Sulfates, Nitrates, Ammonium, Calcium, Acidity.

During May-October 181, automatic, refrigerated, sequential, precipitation samplers were operated at seven locations in Minnesota and Wisconsin. Sites were dispersed in the study area to sample within three major types of ecosystems found in the region. At the northeastern Minnesota sites, an area considered vulnerable to acidic precipitation, concentrations of all major ions except hydrogen were generally lower than at other sites. The higher rainwater acidity at the northern sites appears to be a function of the lower concentrations of alkaline cations such as calcium (2+) ions and ammonium. However, the best single predictor of acidity was sulfate. So-called clean rain may be slightly more acidic than pH 5.6, as indicated by the analysis of the relationships between pH and concentrations of the major ions. Air parcel back trajectories showed that rain in air masses arriving from the northwest quadrant contained the lowest concentrations of sulfate and nitrate, while the majority of rainfall sulfate and nitrate arrived from the south quadrant. (Baker-IVI)
W84-04062

CENTRAL KANSAS FLASH FLOODS OF JUNE 1981,
National Weather Service Forecast Office, Topeka, KS.
For primary bibliographic entry see Field 2E.
W84-04064

STUDY FOR IMPROVING PRECIPITATION OCCURRENCES MODELLING WITH A MARKOV CHAIN,
National Technical Univ., Athens (Greece).
M. Mimikou.
Journal of Hydrology, Vol. 70, No. 1-4, p 25-33, 1984. 1 Fig, 3 Tab, 7 Ref.

Descriptors: *Precipitation, *Markov chain, *Mathematical models, *Greece, Stochastic process, Seasonal variation, Simulation.

Daily precipitation occurrences and their monthly wet-days' sums of seven precipitation stations in Greece are modelled with a Markov chain of seasonally varying order. A method is proposed based on the conjunctive use of a low-order autoregressive stochastic model with a Markov chain, which significantly improves the Markov chain's efficiency for modelling daily precipitation occurrences and their monthly wet-days' sums. With the proposed method for modifying the generation procedure with a Markov chain, not only the monthly wet-days' sums but also the daily precipitation occurrences modelling are significantly improved. The improvement is expected, since this procedure utilizes more information from the historical data; the standard deviation of the sum of wet days is indirectly taken into account. The modified dry day-wet day simulation sequences represent better the historical sequences than the unmodified ones. This is due to the successful selection of the correct criterion for properly distributing inside the month the added or subtracted wet days, than to the additional historical monthly statistical information which is brought into the model. (Moore-IVI)
W84-04141

2C. Snow, Ice, and Frost

ICE FORECASTING MODEL FOR LAKE ERIE,
Ecology and Environment, Inc., Buffalo, NY.
S.-H. Chieh, A. Wake, and R. R. Rumer, Jr.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 4, p 392-415, November, 1983. 14 Fig, 23 Ref. Great Lakes Environmental Research Laboratory contract NA80RAC00148.

Descriptors: *Lake ice, *Forecasting, *Lake Erie, Navigation, Model studies, Mathematical models, Thermodynamics, Wind, Ice cover, Ice drift, Iced lakes.

A previously developed Great Lakes ice forecasting model for winter navigation aid has been calibrated using observed data from specific Lake Erie

ice transport events. The model is based on the macroscopic continuum hypothesis for the fragmented ice field and the internal ice stress is represented by a viscous-plastic type constitutive law. The external driving force includes the time-dependent wind and water current fields as well as the thermodynamic source/sink terms for the ice mass conservation. By adjusting the model coefficients employed in the constitutive equations and the thermodynamic factors, the computed results are in reasonable agreement with the short-term observations for the 1978-79 ice season in Lake Erie. Major findings include the profound effects of the wind-driven water currents and the ice melt at the ice-water interface on the ice regime of Lake Erie during the late stage of the ice season. (Author's abstract)
W84-03797

SOLUTE REDISTRIBUTION DURING NORMAL FREEZING,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 5B.
W84-03831

CORRECTION OF MEASURED PRECIPITATION IN THE ALPS USING THE WATER EQUIVALENT OF NEW SNOW,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
B. Sevruk.
Nordic Hydrology, Vol. 14, No. 2, p 49-58, 1983. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Precipitation, *Measuring instruments, *New snow, *Alps, Temperature effects, Wind, Snowfall, Air temperature.

Considerable systematic losses in winter precipitation measurements in the Alps, using heated and storage gauges, show that corrections of precipitation data are a necessity. For storage gauges the losses are related to wind speed measured near the gauge site. For heated gauges the losses are more complex due to heating and blowing out of snow. The Hellmann heated siphon pluviograph with wind shield showed 56% less winter precipitation than measured on a snow board at an altitude of 2,540 m a.s.l. For the Swiss heated tipping bucket gauge and the storage gauge, precipitation was 31% less. Rough assessments can be made from the portion of snowfall on days with the temperature less than minus 8 degrees C. The results can be used to make a preliminary adjustment of precipitation sums at Alpine gauge sites where wind speeds and temperature can be assessed. (Baker-IVI)
W84-03976

GROWTH MODEL FOR BLACK ICE, SNOW ICE AND SNOW THICKNESS IN SUBARCTIC BASINS,
Merentutkimuslaitos, Helsinki (Finland).
M. Lepparanta.
Nordic Hydrology, Vol. 14, No. 2, p 59-70, 1983. 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Ice thickness, *Model studies, *Subarctic zone, Snow, Ice, Black ice, Density, Temperature, Snowfall, Heat flux.

A model is presented for the growth of ice thickness in autumn and winter. The model includes packing of snow and snow-snow ice transformation. The external input variables include the temperature of the upper surface of the ice sheet, and snowfall and heat flux from the water. Snow-covered floating ice sheet has three distinct layers of frozen water: black ice, snow ice (frozen slush), and snow. Black ice is formed from basin water only. The model predicts the thickness of black ice, snow ice and snow and the density of snow. Thermal inertia is neglected. The results are sensitive to the assumed density of freshly fallen snow and the formulation of snow metamorphism. Comparisons between observations and model calculations are given. The agreement is moderate and the need for field work on snow and ice is noted. The maximum annual ice thickness under varying external conditions is discussed. The model places emphasis on snow metamorphism and tranformation of snow into snow ice as these processes are of great importance in subarctic regions. (Baker-IVI)
W84-03977

SNOWPACK LIQUID WATER DETERMINATIONS USING FREEZING CALORIMETRY,
Resource Consultants, Inc., Fort Collins, CO.
E. B. Jones, A. Rango, and S. M. Howell.
Nordic Hydrology, Vol. 14, No. 3, p 113-126, 1983. 5 Fig, 28 Ref. Contract NAS5-22312, NAS5-23815, NAS5-26062.

Descriptors: *Calorimetry, *Snowpack, Measuring instruments, Forecasting, Runoff, Avalanches, Water supply.

Liquid water in a snowpack, although recognized for some time as a quantifiable parameter of hydrological significance, is not a regularly reported snowpack characteristic due to difficulties with its measurement in the field. Freezing calorimetry is discussed from presentation of theory through the application of the method including formulations for calculating the percent of liquid water in a snowpack. The freezing or cold calorimeter technique was selected primarily because it is relatively inexpensive, it is simple to use, and it is based on known and documented physical phenomena. Because a small amount of liquid water is frozen in the freezing calorimetric approach as opposed to a large amount of ice melted in the melting calorimetric method, the freezing method is more sensitive to variations in liquid water content. Silicon oil has been used successfully as the freezing agent. Consistent results can be obtained with the method, even when using newly-trained operators. Liquid water content data can be obtained approximately every 15 minutes when using two calorimeters and three operators. The freezing calorimetric approach was accurate in determining the liquid water content of the snow to within 1.0 to 2.0% by weight. (Baker-IVI)
W84-03981

2D. Evaporation and Transpiration

EFFECTS OF VEGETATION CONVERSION UPON WATER USE BY RIPARIAN PLANT COMMUNITIES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
L. W. Gay.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153519, Price codes: A09 in paper copy, A01 in microfiche. Completion Report, January, 1984. 175 p, 18 Fig, 14 Tab, 34 Ref, 9 Append. Project No. OWRT B-084-ARIZ (1), Contract/Grant No. 14-34-0001-9146.

Descriptors: *Evapotranspiration, *Consumptive use, *Phreatophytes, Colorado River, Plant communities, Saltcedar, Data collection, Bowen ratio system, Measurement.

Evapotranspiration was measured at two points simultaneously over a dense stand of saltcedar on the lower Colorado River with a computerized, portable Bowen ratio system. Twenty-one days of good ET data were collected during two successive years on eight different expeditions within the April-November growing season. In addition, potential ET (PET) estimates were developed for four models (radiaton, radiation and temperature, net radiation and Penman combination) using climatological data from two weather stations at nearby Blythe, California. ET from the saltcedar ranged up above 12 mm per day in midsummer. The March 23-Nov. 11 growing season total was estimated from these measurements to be 1677 mm, including 40 mm of evaporated precipitation, and annual total ET was estimated to be 1727 mm. The climatological estimates of PET were converted to actual ET (AET) by a 4th-order calibrating function developed by regressing daily totals of measured Bowen ratio ET against estimated PET. Seasonal totals of AET were in excellent agreement and averaged 1756 mm. There was little difference between the two years. The two approaches suggest that 1750 and 1800 mm are reasonable figures for growing season ET and for annual ET from well-developed saltcedar on the lower Colorado. A simple radiation model appears suitable for estimating seasonal AET totals in this region if weather data are limited, and direct measurements of ET are lacking. The report describes the instrumentation, measurements and analysis techniques needed to develop measurements of AET from climatological estimates of PET.
W84-03661

MODELLING DAILY EVAPOTRANSPIRATION USING REMOTELY SENSED DATA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 7B.
W84-03790

BARE-SOIL EVAPORATION DETERMINED IN SITU BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
J. Ben-Asher, A. W. Warrick, and A. D. Matthias.
Journal of Hydrology, Vol. 69, No. 1-4, p 325-334, February, 1984. 8 Fig, 5 Ref.

Descriptors: *Evaporation, *Infrared thermometry, Surface temperature, Wind velocity, Model studies, Parametric hydrology, Hydrologic budget.

Soil properties exhibit random spatial fluctuations and most irrigation methods are systematically non-uniform. Thus the only way to account for the randomness of natural soil variations and the gradual changes in water application is to describe its components statistically instead of deterministically. This can be achieved by expressing the water balance equation terms as random variables. Bare-soil evaporation was measured in situ by infrared thermometry. Measurements were made at 25 sites on a 20 x 20-m plot. About 17 mm of water were added during the first test in March 1982 and 27 mm during a second experiment in May, both in a rainless and sunny period. The method requires measurement of wind speed, the maximum surface temperature of the test soil and a reference dry surface. Measured values of the evaporation were well correlated (r to the 2 power = 0.7) with water added, and the amount of evaporation measured for a 1-week period was of the same order of magnitude as the added water. Supporting information of surface water content by gravimetric and neutron measurements helped to complete water-balance calculations on each site. The method is proposed as a tool for evaluating spatial variability for water-balance studies in large areas. Semi-variograms were prepared for evaporation on the site and fitted by assuming a linear drift. (Murphy-IVI)
W84-03791

EVAPORATION FROM A BARE SOIL EVALUATED USING A SOIL WATER TRANSFER MODEL AND REMOTELY SENSED SURFACE SOIL MOISTURE DATA,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
L. Prevot, R. Bernard, O. Taconet, and D. Vidal-Madjar.
Water Resources Research, Vol. 20, No. 2, p 311-316, February, 1984. 9 Fig, 2 Tab, 7 Ref.

Descriptors: *Evaporation, *Soil water, *Model studies, *Remote sensing, Hydrologic budget, Evapotranspiration, Boundary conditions, Rainfall.

Actual evapotranspiration is an important quantity in climatology, hydrology, and agronomy but its characterization at regional scale appears to be rather difficult. Remote sensing techniques, which are well suited for large-scale measurements, might allow a regional approach to evaporation. A soil water transfer model has been used to estimate the soil water budget and evaporation using remotely sensed surface soil moisture data, with accuracy comparable to that of neutron probe measurements, without rain simulation. The with rain model yielded inferior estimates of evaporation and

2E. Streamflow and Runoff

water budget due partly to numerical difficulties but also to the lack of radar data between the rain events. Daily surface soil moisture data, obtained with a C band scatterometer on a bare soil, provide the upper boundary condition for the model which uses an implicit finite difference scheme to solve the nonlinear Richards equation. The soil is represented by two layers differing in hydraulic conductivity. (Baker-IVI)
W84-03827

WATER TRANSFER IN PLANTS; I. - SCALE MODELLING OF PLANT CANOPY IN NATURAL CONDITIONS (TRANSFERT HYDRIQUE DANS LE VEGETAL I. - MODELISATION A LECHELLE DU COUVERT VEGETAL EN CONDITIONS NATURELLES),
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
N. Katerji, M. Hallaire, A. Perrier, and R. Durand.
Acta Oecologia-Oecologia Plantarum, Vol. 4, No. 1, p 11-26, 1983. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Transpiration, *Plant water potential, Water storage, Water loss, Transport depletion, Alfalfa, Model studies, Canopy.

Measurements made in a field of alfalfa of hourly transpiration rate and of the corresponding difference between soil and foliage water potential, showed a non-linear relation. Similar results have been reported by others and, from these, it has been concluded that the plant resistance to liquid flow is not constant, but tends to decrease as the flow-rate increases. However, an analysis of the data with a model that includes a water storage reservoir of variable content in the plant system, showed that the actual absorption (transpiration minus, the contribution of the reservoir-plant), rather than the rate of water loss from the crop, closely adheres to a linear model. Hence, the hydraulic resistance is shown to be constant, with a value of about 25 bar h/mm for an alfalfa crop of LAI around 3. In an appendix the method for deriving the model parameters is given in detail, together with an error analysis. (Author's abstract)
W84-03871

WATER TRANSFER IN PLANTS; II. - FIELD DETERMINATION OF PLANT CANOPY WATER CONTENT VARIATIONS, (TRANSFERT HYDRIQUE DANS LE VEGETAL; II. - DETERMINATION AU CHAMP DES VARIATIONS DE CONTENU EN EAU DU COUVERT VEGETAL),
Institut National de la Recherche Agronomique, Versailles (France). Station de Bioclimatologie.
N. Katerji, M. Hallaire, Y. Menoux-Boyer, and A. Perrier.
Acta Oecologia-Oecologia Plantarum, Vol. 4, No. 2, p 171-181, 1983. 7 Fig, 21 Ref.

Descriptors: *Water transfer, *Canopy, Plant water potential, Lucerne, Water vapor, Water loss, Hydrologic cycle, Water deficit.

A previously presented model for water circulation within plants suggested a method for determining, from transpiration and water potential measurements, the amounts of water lost and recovered during the course of the day by the plant canopy. Applied to a lucerne canopy over a period of about twenty days, this method led to a set of plausible results which thus seem to comfirm the model's validity. As opposed to the case of other methods which apply only to the aerial parts, the data obtained here includes the root system contribution; for lucerne canopy studied, this contribution corresponds to two third of the water lost by the plant. The possibilities of increasing accuracy while simultaneously simplifying measurements are examined, as well as possible limitations in the method's application notably in the case of great soil dryness. (Murphy-IVI)
W84-03874

EVAPORATION REDUCTION: SUMMARY OF LONG-TERM TANK STUDIES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 3B.
W84-04039

EVAPORATION FROM SALINE LAKES: A COMBINATION EQUATION APPROACH,
Institute of Hydrology, Wallingford (England).
I. R. Calder, and C. Neal.
Hydrological Sciences Journal, Vol. 29, No. 1, p 89-97, 1984. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Saline lakes, *Evaporation, *Model studies, Mathematical equations, Dead Sea, Lakes, Temperature effects, Solutes, Solubility.

A modification is made to the conventional evaporation equation to allow the calculation of evaporation from saline lakes. The modified equation shows how, for a given set of meteorological conditions, the evaporation rate, the partitioning of available energy into sensible and latent heat, and the surface temperature, can all be related to solute concentrations. To illustrate the operation of the equation the recent and proposed changes to the hydrology of the Dead Sea were used as a case study. The meteorological inputs to the model cannot, however, be considered to be wholly independent of the activity of the water in solution. A decrease in lake temperature, caused by an increase in the activity of water in solution, will reduce long-wave back radiation from the lake thereby increasing net radiation, changing the atmospheric stability conditions and increasing the aerodynamic resistance, and modifying to some extent the temperature and humidity of the air above the lake. The magnitude of the model prediction errors will be largely determined by the uncertainties in the measurement of the meteorological input data and the estimate of the aerodynamic resistance. It is unrealistic to assume an accuracy of better than perhaps 10-15% in any of the quantities, which will result in model prediction errors of at least a similar magnitude. (Baker-IVI)
W84-04072

BLANEY-MORIN-NIGERIA EVAPOTRANSPIRATION MODEL,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
J. O. Duru.
Journal of Hydrology, Vol. 70, No. 1-4, p 71-83, 1984. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Evapotranspiration, *Mathematical models, *Nigeria, Temperature, Relative humidity, Solar radiation, Wind, Developing countries.

In Nigeria, and perhaps in other developing countries, there is a need to compute evapotranspiration (Et) from those meteorological parameters which can be easily measured. An evapotranspiration model has been developed for application in Nigeria. The model, designated as the Blaney-Morin-Nigeria evapotranspiration model, predicts potential evapotranspiration with accuracy and consistency that are better than the Penman model, under Nigerian conditions. The proposed model implies that, under Nigerian conditions, accurate prediction of Et can be obtained from temperature, relative humidity and radiation. The effect of wind can be ignored without much loss of accuracy. This can be seen from the fact that the Blaney-Morin-Nigeria model proved to be a better predictor than the Penman model, which considers wind effects, in both a high-wind region and a low-wind region. The Blaney-Morin evapotranspiration concept may have similar potential elsewhere when given specific form with appropriate constants derived to reflect climatic peculiarities. (Moore-IVI)
W84-04143

WATER LOSS AND MALATE FLUCTUATIONS DURING THE DAY FOR PLANTS IN THE SOUTHERN NAMIB DESERT,
Bayreuth Univ. (Germany, F.R.).
For primary bibliographic entry see Field 2I.
W84-04176

INITIAL ASSESSMENT OF TIME OF TRAVEL AND MIXING THROUGH GULF ISLAND POND AND THE LOWER ANDROSCOGGIN RIVER, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
G. W. Parker, and S. Hunt.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $7.75 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 83-4020, 1983. 53 p, 38 Fig, 6 Tab, 8 Ref.

Descriptors: *Rivers, *Marking techniques, *Reservoir, *Mixing, Hydrology, Streamflow, Tracer, Stratification, Inflow, Unsteady flow, Stratified flow, Analysis, Fluorometry, *Maine, *Time-of-travel, Androscoggin River, Gulf Island Pond.

Flow-stratification patterns were observed in Gulf Island Pond during time-of-travel studies in May and August 1980. The stratification patterns in this 70 million cubic-meter impoundment were due to a temperature differences between inflowing water and reservoir water. Separation was observed at temperature differences of 0.5 degrees C in May 1980 and 1.0 degrees C in August 1980. The pathway taken by inflowing water through the reservoir was governed by the temperature-related density forces acting between the two water masses. Data collected during August 1980 to define differences in dye concentrations with depth at two fixed profile points in Gulf Island Pond showed average water velocity to be seven times faster near the bottom than near the surface. A concept of mass flow was used to analyze data collected at sites downstream from Gulf Island Dam where flow varied rapidly with time. This report presents the mathematical derivation of controid traveltime, skewness, and percentage recovery of dye mass as determined from mass versus time curves. (USGS)
W84-03552

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN NORTHEASTERN AND WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
C. Parrett, R. J. Omang, and J. A. Hull.
USGS Water-Resources Investigations Report 83-4046, June, 1983. 53 p, 8 Fig, 8 Tab, 24 Ref.

Descriptors: *Annual runoff, Regression analysis, Estimating equations, Peak discharge, *Mean flow, Gaging station, Active-channel width, Bankfull width, *Channel geometry, *Montana.

Equations for estimating mean annual runoff and peak discharge from measurements of channel geometry were developed for western and northeastern Montana. The study area was divided into two regions for the mean annual runoff analysis, and separate multiple-regression equations were developed for each region. The active-channel width was determined to be the most important independent variable in each region. The standard error of estimate for the estimating equation using active-channel width was 61 percent in the Northeast Region and 38 percent in the West region. The study area was divided into six regions for the peak discharge analysis, and multiple regression equations relating channel geometry and basin characteristics to peak discharges having recurrence intervals of 2, 5, 10, 25, 50 and 100 years were developed for each region. The standard errors of estimate for the regression equations using only channel width as an independent variable ranged from 35 to 105 percent. The standard errors improved in four regions as basin characteristics were added to the estimating equations. (USGS)
W84-03556

ESTIMATED NATURAL STREAMFLOW IN THE RIO SAN JOSE UPSTREAM FROM THE PUEBLOS OF ACOMA AND LAGUNA, NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Risser.
USGS Water-Resources Investigations Report 82-4096, 1982. 51 p, 10 Fig, 6 Tab, 16 Ref.

Descriptors: *Streamflow, *Streamflow depletion, *Reservoir evaporation, Rainfall-runoff relationships, Springs, Surface water records, *New Mexico, Pueblo of Laguna, Pueblo of Acoma, Bluewater Lake.

The development of surface and ground water, which began about 1870 in the upper Rio San Jose drainage basin, has decreased the flow of the Rio San Jose on the Pueblo of Acoma and the Pueblo of Laguna. The purpose of this study was to estimate the natural streamflow in the Rio San Jose that would have entered the pueblos if no upstream water development had taken place. Estimates of natural flow were based upon streamflow and precipitation records, historical accounts of streamflow, records of irrigated acreage, and empirically-derived estimates of the effects on streamflow of Bluewater Lake, groundwater withdrawals, and irrigation diversions. Natural streamflow in the Rio San Jose at the western boundary of the Pueblo of Acoma is estimated to be between 13,000 and 15,000 acre-feet per year, based on 55 years of recorded and reconstructed streamflow data from water years 1913 to 1972. Natural streamflow at the western boundary of the Pueblo of Laguna is estimated to be between 17,000 and 19,000 acre-feet per year for the same period. The error in these estimates of natural streamflow is difficult to assess accurately, but it probably is less than 25 percent. (USGS)
W84-03560

UNCERTAINTIES IN RECORDS OF ANNUAL MEAN DISCHARGE IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03564

USE OF DIGITAL LAND-COVER DATA FROM THE LANDSAT SATELLITE IN ESTIMATING STREAMFLOW CHARACTERISTICS IN THE CUMBERLAND PLATEAU OF TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
E. F. Hollyday, and G. R. Hansen.
USGS Water-Resources Investigations Report 82-4059, 1983. 45 p, 4 Fig, 9 Tab, 17 Ref.

Descriptors: Hydrology, *Remote sensing, *Watersheds (basins), *Hydrologic networks, Satellites, Terrain analysis, Floods, Low flow, *Tennessee, Cumberland Plateau, *Statistical analysis, Computer processing, Multi-spectral image analysis, Multiple linear regression.

Streamflow may be estimated with regression equations that relate streamflow characteristics to characteristics of the drainage basin. A statistical experiment was performed to compare the accuracy of equations using basin characteristics derived from maps and climatological records (control group equations) with the accuracy of equations using basin characteristics derived from Landsat data as well as maps and climatological records (experimental group equations). Results show that when the equations in both groups are arranged into six flow categories, there is no substantial difference in accuracy between control group equations and experimental group equations for this particular site where drainage area accounts for more than 90 percent of the variance in all streamflow characteristics (except low flows and most annual peak logarithms). (USGS)
W84-03566

MAN-INDUCED CHANNEL ADJUSTMENT IN TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-03567

FLOODS IN KANSAS CITY, MISSOURI, AND VICINITY, AUGUST 12-13, 1982,
Geological Survey, Rolla, MO. Water Resources Div.
L. D. Becker, T. W. Alexander, and L. A. Waite.
USGS Water-Resources Investigations Report 83-4141, 1983. 35 p, 13 Fig, 4 Tab, 11 Ref.

Descriptors: *Floods, *Urban runoff, *Flash floods, *Flood peak, Surface runoff, Storm runoff, Runoff volume, Stream gages, Flood recurrence-interval, Surface water, *Missouri, Jackson County, Clay County, Cass County, *Kansas City.

On August 12-13, 1982, a nearly stationary weather front in the vicinity of Kansas City, MO, produced intense thunderstorms. Excessive rainfall (12.6 inches in Raytown, MO) caused flash flooding during the nighttime and early daylight hours. Four deaths and damages unofficially estimated in excess of $30 million, occurred in the three-county area of Jackson, Cass, and Clay counties. Peak discharges were determined at 12 current or discontinued streamflow-gaging stations and 17 miscellaneous sites. Flood peaks and volumes at many locations exceeded estimated 100-year recurrence-interval floods and equaled or exceeded the 1977 floods in some drainage basins. Significant flooding occurred in the Blue, East Fork Little Blue, and Little Blue River basins and in the Rock, Wilkerson, Sni-A-Bar, Shoal, and Big Creek drainage basins. (USGS)
W84-03576

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1981 AND 1982.
Geological Survey, Cheyenne, WY. Water Resources Div.
USGS Open-File Report 83-254, 1983. 116 p, 11 Fig, 5 Tab. S. L. Green, compiler.

Descriptors: Water resources, *Hydrologic data, *Wyoming, Streamflow, Sediment load, Water quality, Groundwater, Water supply, Environmental effects, Oil shale, Coal regions.

This report contains lists and location maps of streamflow and reservoir stations, peak-flow partial-record stations, water quality stations, sediment stations, and ground-water stations that are currently being operated. Water-resources appraisal projects in Wyoming are also described, including many that are related to development of energy resources. The general locations of the projects are shown on maps. The U.S. Geological Survey is striving to coordinate its water-resources investigations with those of other agencies. This report is one phase of that coordination effort, and serves as an annual progress report to cooperators and the public. (USGS)
W84-03580

CHEMICAL AND HYDROLOGIC ASSESSMENT OF THE CALOOSAHATCHEE RIVER BASIN, LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
H. R. La Rose, and B. F. McPherson.
USGS Water-Resources Investigations Report 83-4126, 1983. 63 p, 18 Fig, 15 Tab, 18 Ref.

Descriptors: *Nutrients, Flow, Canals, *Salinity, Algae, *Eutrophication, Caloosahatchee River, Caloosahatchee Canal, *Florida.

Annual discharge (1970-79 water years) from Lake Okeechobee to the Caloosahatchee River averaged 51 percent of the total river discharge at Franklin Lock and ranged from 10 to 71 percent of total discharge. Excluding rainfall on the river surface and upstream seepage, surface and subsurface runoff from the basin accounted for the remaining total river discharge at Franklin Lock. Nitrogen and phosphorus were in sufficient supply most of the time to support algal growth in the river. During algal blooms, however, nitrite plus nitrate nitrogen was depleted and probably became limiting. Nitrite plus nitrate was the predominant form of inorganic nitrogen in the river and in most tributaries. Average concentrations in the river were 0.18 to 0.21 milligram per liter. Average concentrations in most tributaries were less than those in the river. Average concentrations of total phosphorus in many tributaries fell within the same range as that in the river (0.08 to 0.15 milligram per liter), but some tributaries in the eastern part of the basin had greater average concentrations. (USGS)
W84-03591

TIME-OF-TRAVEL AND DISPERSION STUDIES, LEHIGH RIVER, FRANCIS E. WALTER LAKE TO EASTON, PENNSYLVANIA,
Geological Survey, Harrisburg, PA. Water Resources Div.
C. D. Kauffman, Jr.
USGS Open-File Report 82-861, May, 1983. 32 p, 20 Fig, 5 Tab, 4 Ref.

Descriptors: *Tracers, *Dispersion, *Dilution, *Velocity, Streamflow, Time-of-travel, Concentration attenuation, Lehigh River, *Pennsylvania.

Results of time-of-travel and dispersion studies are presented for the 77.0 mile reach of the Lehigh River from Francis E. Walter Lake to Easton, Pennsylvania. Rhodamine WT dye was injected at several points for a variety of several common flow conditions and its downstream travel was monitored at a number of downstream points by means of a fluorometer. Time-of-travel data have been related to stream discharge, distance along the river channel and dispersion. If 2.205 pounds of a conservative water soluble contaminant were accidentally spilled into the Lehigh River at Penn Haven Junction at Black Creek 6.09 miles downstream from Rockport, Pennsylvania, when the discharge at Walnutport, Pennsylvania, was 600 cubic feet per second, the leading edge, peak, and trailing edge of the contaminant would arrive 31.6 miles downstream at the Northhampton, Pennsylvania, water intakes 45, 54, and 66 hours later, respectively. The maximum concentration expected at the intakes would be about 1.450 micrograms per liter. From data and relations presented, time-of-travel and maximum concentration estimates can be made for any two points within the reach. (USGS)
W84-03603

BASE FLOW AND GROUND WATER IN UPPER SWEETWATER VALLEY, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
R. D. Evaldi, and J. G. Lewis.
USGS Water-Resources Investigations Report 83-4068, 1983. 30 p, 18 Fig, 8 Tab, 14 Ref.

Descriptors: Water resources, *Karst, *Limestone, Solutioning, Solution cavities, Hydrology, Hydrogeology, Carbonate-rock hydrology, Well supplies, *Base flow, *Tennessee, Valley and Ridge Physiographic Province, Monroe County, McMinn County, Loudon County, Sweetwater Valley.

Base flow measurements showed interbasin transfer of water among sub-basins of upper Sweetwater Valley. In general, topographically higher subbasins have deficient surface outflow unless significant spring flow occurs in the basin. Topographically lower areas adjacent to the main channel of Sweetwater Creek generally have surplus flow. Major flow surpluses were associated with areas in which the majority of flow originated at a spring. Unusual outflow was related to geology to hypothesize a ground-water flow network. Areas of ground-water flow up-gradient of large springs were hypothesized as likely areas for significant ground-water reservoirs. A water budget study indicated that during dry years approximately three-fourths of the annual flow to Sweetwater Creek may be derived from ground-water sources. Streamflow records were analyzed to estimate the frequency of low-flow of Sweetwater Creek. (USGS)
W84-03605

UNIFIED NATIONAL PROGRAM FOR FLOOD PLAIN MANAGEMENT.
Water Resources Council, Washington, DC.
For primary bibliographic entry see Field 6F.
W84-03664

TWO APPROACHES FOR ESTIMATION OF MANNING'S N IN MOUNTAIN STREAMS,
Wyoming Water Research Center, Laramie.
T. A. Wesche, W. T. Hill, and V. R. Hasfurther.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154400, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September, 1983. 48 p, 17 Fig, 7 Tab, 14 Ref. Project No. OWRT A-030-WYO (2), Contract/Grant No. 14-34-0001-2154.

Descriptors: Natural streams, *Manning's Equation, *Roughness coefficient, Velocity, *Flow characteristics, Hydraulic models, Rocky Mountain region, Errors, Manning's n, Roughness (hydraulic).

An analysis of roughness coefficients for mountain streams in the Rocky Mountain Region was conducted to devise an empirical method for determination of Manning's n. Two approaches were developed. One procedure utilizes a diagrammatic key approach based upon water surface slope and observable channel characteristics, while the other attempts to relate the time-of-travel velocity of a dye cloud through a stream reach to channel roughness. The conclusions drawn indicate that good potential exists for the use of the diagrammatic key approach. A second significant conclusion of the study is that the estimation of n for steep, rough, tributaries at low flow by means of published tables and/or photographic comparisons can lead to erroneous results.
W84-03666

MAGNITUDE AND FREQUENCY OF FLOODS IN NEW JERSEY WITH EFFECTS OF URBANIZATION,
S. J. Stankowski.
Special Report 38, New Jersey Dept. of Environmental Protection, 1974. 46 p, 15 Fig, 7 Tab, 22 Ref.

Descriptors: *Flood peak, *Model studies, *Flood basins, *Flood recurrence interval, *Flood profiles, *Regional floods, Historic floods, Catchment areas, Maximum probable floods, Flood plain management, Mathematical models, Mathematical analysis, Floods.

This study developed an inexpensive and rapid method for estimating flood-peak magnitudes having recurrence intervals ranging up to 100 years for drainage basins larger than one square mile. The basins had various degrees of urban and suburban development. The method had to be applicable at open-channel sites on any nontidal New Jersey stream where flood flow is not significantly affected by upstream reservoir operation. Mathematical and graphical relations are presented to estimate flood-peak magnitudes; four parameters are required to use these relations. Three of these may be measured from topographic maps, i.e., basin size, channel slope, and surface storage within the basin. The fourth is an index of man-made impervious cover which can be determined for existing and future development conditions from census data and from readily available population projections. Developed from an analysis of flood information for 103 sites in New Jersey (the average period of record for the stations was 27 years), the relations should be useful for design of bridge waterway openings, selection of optimum size for drainage structures, evaluation of flood hazards for alternative land-use plans, and for definition of floodway and flood-hazard-area limits. Statewide averages indicate that urban and suburban development increases flood peaks up to three times at the 2-year recurrence interval and up to 1.8 times at the 100-year recurrence interval. (Garrison-Omniplan)
W84-03684

FLOODS OF AUGUST AND SEPTEMBER 1971 IN NEW JERSEY,
S. J. Stankowski.
Special Report, New Jersey Dept. of Environmental Protection, 1972. 204 p, 77 Fig, 9 Tab, 11 Ref, 1 Append.

Descriptors: *Historic floods, *Flash floods, *Storm water, *Rainstorms, *Precipitation, *Rainfall impact, Flood-plain management, Rainfall, Gaging stations, Flood peak, Rivers, Bridge design.

Floods of unprecedented magnitude in August 1971 created havoc in south-central, central and northeastern New Jersey. Then, record-breaking floods in September 1971 occurred in the highly urbanized basins of northeastern New Jersey. Total storm rainfall amounts in August during a 32-hour period ranged from about 3 to over 11 inches across New Jersey. River levels reached stages greater than any previously known in many areas of the state. The September flood averaged about 7 inches in northeastern New Jersey and caused recordbreaking peak flows in many streams. Detailed hydrologic data are provided on precipitation, stage and discharge for each gaging station during the period of storm runoff, flood stages and discharges, a comparison with the maximum floods previously known, and the estimated recurrence level. Flood-crest elevations are tabulated for more than 700 sites, in addition to the gaging stations. Flood profiles are shown for 36 streams. The stations at which new peak discharges were recorded had periods of record, in 1971, ranging from 1 to 51 years. New peak discharges were established at 17 stream-gaging stations with more than 30 years of record. The data presented may be used for planning and designing hydraulic structures and flood-protection works, for bridge and culvert design, for flood-plain management and flood insurance purposes, and for water-supply volume studies. (Garrison-Omniplan)
W84-03685

TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF PENNSYLVANIA STREAMS,
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03688

HINDCASTING MONTHLY RUNOFF,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
E. F. Brater, and R. Wallace.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 126-141, February, 1984. 7 Fig, 2 Tab, 9 Ref, 1 Append.

Descriptors: *Hindcasting, *Runoff, *Precipitation rate, Temperature, Rainfall-runoff relationships, Gaging, Hydrologic budget, History, Water loss, Water storage.

Research was carried out to develop relatively simple low cost procedures for estimating chronological monthly runoff for the historical period before a gaging station was installed on the river but during which precipitation and temperature records are available. The method also supplies estimates of runoff during periods of missing records. The procedures are based on the equation for the water budget of a drainage basin which shows runoff to be a function of precipitation, water losses, and the change in storage. It is shown that current and antecedent precipitation and temperature can be used as independant variables to account for the water loss and storage terms. The methods were tested by calibrating the models for the more recent years of records and then hindcasting runoff for earlier periods during which measured runoff was available for comparison. (Author's abstract)
W84-03718

MEASUREMENT OF STREAMWISE VORTICITY FLUCTUATIONS IN A TURBULENT CHANNEL FLOW,
Max-Planck-Inst. fuer Stroemungsforschung, Goettingen (Germany, F.R.).
E. G. Kastrinakis, and H. Eckelmann.
Journal of Fluid Mechanics, Vol. 137, p 165-186, December, 1983. 23 Fig, 37 Ref.

Descriptors: *Channel flow, *Turbulent flow, Measuring instruments, Vorticity, Flow, Velocity, Streams.

Measurements of streamwise vorticity fluctuations have been made in a fully developed turbulent channel flow. A newly designed probe provided simultaneously in addition to the vorticity signal all three velocity signals. The new probe resembles the Kovasznay-type vorticity probe, but consists of four electrically independent hot wires, each mounted separately on a total of eight supporting prongs. A new calibration technique had to be developed for this probe. A strong increase of flatness factor with wall distance indicates a strongly intermittent character for the streamwise component of vorticity in this region. The flatness factor shows values similar to those for the three fluctuating velocity components only in the vicinity of the wall, where most streamwise vortices are observed. (Baker-IVI)
W84-03772

NEW NON-LINEAR CONCEPTUAL MODEL OF FLOOD WAVES,
Polish Academy of Sciences, Warsaw. Inst. of Geophysics.
J. J. Napiorkowski, and P. O'Kane.
Journal of Hydrology, Vol. 69, No. 1, p 43-58, February, 1984. 5 Fig, 13 Ref.

Descriptors: *Flood waves, *Model studies, St. Venant's model, Open channels, Hydrologic models, Simulation.

St. Venant's nonlinear distributed model of flood waves in open channels has been successfully simulated using a much simpler nonlinear lumped conceptual model. This simpler model is composed of a cascade of equal nonlinear storage elements preceded by an element of pure delay. The linear channel (a pure translatory system) reflects the time of propagation of a perturbation along the positive characteristic. The cascade of nonlinear reservoirs is responsible for the attenuation of the system response. The simpler model depends on four parameters only. The first two terms of the Taylor expansion of the state trajectory are shown to be equivalent to the first two terms of a Volterra convolution series. An example is offered to demonstrate the accuracy of this quadratic approximation. (Baker-IVI)
W84-03776

FLOOD ROUTING BY A LINEAR SYSTEMS ANALYSIS TECHNIQUE,
Ministry of Works and Development, Christchurch (New Zealand).
D. G. Goring.
Journal of Hydrology, Vol. 69, No. 1, p 59-76, February, 1984. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Flood routing, *Model studies, Linear programming, Systems analysis, Hydrologic models, River systems, Estimating, Forecasting.

There are two modes of flood routing: simulation and forecasting. A hydrological technique for flood routing using linear systems analysis has been presented and applied to a practical case both in the simulation and the forecasting mode. This method has particular application in river systems where the contribution from ungauged tributaries is significant. The method gives the peak flow within 12% accuracy in both modes in an example where only 57% of the total flow into the system was available for analysis. From a hydraulician's point of view, the main problem with a linear model for routing floods is that it may underestimate the wave speed. However, the linear systems method allows for this and the time of the flood peak usually is estimated within one time unit on either side of the actual time. (Baker-IVI)
W84-03777

TESTING PHYSICALLY-BASED FLOOD FORECASTING MODEL (TOPMODEL) FOR THREE U.K. CATCHMENTS,
Institute of Hydrology, Wallingford (England).
K. J. Beven, M. J. Kirkby, N. Schofield, and A. F. Tagg.
Journal of Hydrology, Vol. 69, No. 1-4, p 119-143, February, 1984. 13 Fig, 4 Tab, 23 Ref. N.E.R.C. grant GR3/2119.

Descriptors: *Flood forecasting, *Model studies, *Catchment areas, Crimple Beck, Hodge Beck, Wye headwater, Wales, Rainfall-runoff relationships, Rainfall, Evaporation, TOPMODEL, Model testing.

For many years, attempts at modelling the complex processes by which a basin converts rainfall to runoff were largely concerned with using lumped analogues. More recently, attention has concentrated on the 'contributing area' concept, so that is now accepted that the dynamic spatial variability of these runoff source areas must be treated more effectively. A previously developed model has been tested on three catchments: Crimple Beck (8 sq km) near Harrogate, Hodge Beck (36 sq km) on the North York Moors and the Wye headwater (10.5 sq km) in central Wales. The model was originally validated on subcatchments within Crimple Beck. For this study forecasts were made over a period of one year, based only on rainfall and evaporation data. The model parameters were derived from a defined program of field measurements over a period of 2-4 weeks, and no formal optimization procedures were carried out before comparing forecasts with the measured stream discharge record. As a result of the comparisons, the model is seen as a useful approach for ungauged catchments of up to 500 sq km in humid-temperature climates. (Murphy-IVI)
W84-03779

METHOD FOR THE DETERMINATION OF THE DISCHARGE-FREQUENCY RELATIONSHIP IN UNGAGED ARID GRAVEL STREAMS,
Geological Survey of Israel, Jerusalem.
A. B. Begin, and M. Inbar.
Journal of Hydrology, Vol. 69, No. 1-4, p 163-172, February, 1984. 5 Fig, 1 Tab, 6 Ref.

Descriptors: *Flows, *Model studies, *Stream discharge, Drainage basins, Stream beds, Negev, Israel, Arid regions, Geomorphology.

Significant statistical relationships were defined between shear stress exerted by flows of certain recurrence intervals on stream beds and grain-size distribution. Based on these relationships it is proposed to determine discharge-frequency curves in ungaged reaches of the arid Negev of Israel. Application of this method requires measurement of the hydraulic geometry of the desired reach and the grain size of some samples in it. The method was applied to the lower reach of Nahla Zin and the 50-and 100-yr peak discharges were estimated. The results agreed with an estimate based on an assessment of discharge per unit area in the same drainage basin. (Baker-IVI)
W84-03781

STOCHASTIC ANALYSIS OF HIGH FLOWS GENERATED BY MIXED PROCESSES,
Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen, and M.-K. Woo.
Canadian Journal of Civil Engineering, Vol. 10, No. 4, p 639-648, December, 1983. 6 Fig, 4 Tab, 6 Ref.

Descriptors: *Stochastic hydrology, *High flows, *Flood flow, Model studies, Probabilistic process, Mathematical studies, Snowmelt, Rainfall, Floods, Prediction, British Columbia.

Concepts previously developed and tested to analyze floods generated by a single process have been extended so as to be applicable to high flows resulting from more than one hydrological process. The method described preserves a theoretical and physical basis. A subdivision of the nonhomogeneous high flow data on the grounds of clearly definable hydrological processes also tends to improve the prediction of flood probabilities. The procedures are easy to apply and investigation of flood characteristics at increasingly higher truncation levels supports the finding that a complete reanalysis of data is not necessary, thus simplifying the computational task when information pertaining to various flood levels is required. The methodology is applied to three basins in southwestern British Columbia that experience both snowmelt and rainfall generated floods. (Baker-IVI)
W84-03799

ROLE OF CURRENT VELOCITY IN STRUCTURING EELGRASS (ZOSTERA MARINA L.) MEADOWS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. S. Fonseca, J. C. Zieman, G. W. Thayer, and J. S. Fisher.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 367-380, October, 1983. 5 Fig, 3 Tab, 27 Ref. NSF, International Decade of Ocean Exploration, Seagrass Ecosystem Study grant OCE77-27051.

Descriptors: *Water currents, *Velocity, *Eelgrass, Sediment distribution, Equilibrium, Habitats.

Measurements of velocity profiles, bathymetry, and surface sediment characteristics across eelgrass (Zostera marina L.) meadows yielded information on community development processes and functional attributes of this ecosytem. Height/length ratios of the meadows were positively correlated with tidal current velocity. Low, medium, and high current regimes were separated by surface current velocities of approximately 50 and 90 cm/s. Z. marina can tolerate approximately 120-150 cm/sec current velocities in the areas studied. Per cent silt-clay and organic matter content of the surface sediments are negatively associated with shead velocity, suggesting that meadows in high current areas are sources while meadows in low current areas are sinks of autochthonous detritus. Current velocity maintains seagrass meadows at different equilibrium levels (relative climaxes). We theorize these different equilibrium levels provide unequal habitat utilization potentials for the associated faunal community. (Author's abstract)
W84-03803

MODELING RAPIDLY VARIED FLOW IN TAILWATERS,
Army Command and General Staff Coll., Fort Leavenworth, KS.
M. G. Ferrick, J. Bilmes, and S. E. Long.
Water Resources Research, Vol. 20, No. 2, p 271-289, February, 1984. 20 Fig, 19 Ref.

Descriptors: *Hydrologic models, *Tailwater, *Varied flow, Waves, Hydroelectric power, Physical properties, Mathematical models, Flow regimes.

An understanding of the downstream propagation of sharp-fronted, large-amplitude waves of relatively short period is important for describing rapidly varying flows in tailwaters of hydroelectric plants and following the breach of a dam. A numerical model of these waves was developed by first identifying the primary physical processes and then performing an analysis of the solution. A linear analysis of the dynamic open channel flow equations provides relationships describing flow wave advection, diffusion, and dispersion in rivers. A one-dimensional diffusion wave model modified for application to tailwaters simulates the important physical processes and is straightforward to apply. The 'modified equation' and von Neumann analyses provide insight into the effects of numerical parameters theta, delta x, and delta t upon stabiity and dissipative and dispersive behavior of the solution, but the Hirt analysis is found to yield incorrect phase relationships. The capability and accuracy of the model are enchanced when physical diffusion of a river wave is balanced by numerical diffusion in the model. Field studies were conducted in two greatly different tailwaters to assess our understanding of large-scale, rapidly varying flow waves. The accurate simulation of waves having wide-ranging amplitudes, shapes, periods, and base flows attests to the soundness of both the physical basis of the model and the numerical solution technique. These studies reveal that diffusion of short-period waves in natural, free-flowing rivers is signficiant and that inertia is negligible. (Murphy-IVI)
W84-03824

FLOOD ESTIMATES FOR UNGAGED STREAMS IN GLACIER AND YELLOWSTONE NATIONAL PARKS, MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
USGS Water-Resources Investigations Report 83-4147, July, 198. 10 p, 2 Fig, 2 Tab, 4 Ref.

Descriptors: Water rights, Regression analysis, Estimating equations, Streamflow, Drainage area, Glacier National Park, Yellowstone National Park, Basin characteristics, *Montana.

Estimates of 100-year discharges were made at 59 sites in Glacier National Park and 21 sites in Yellowstone National Park to assist the National Park Services in quantifying stream inflow and outflow in the Parks. The estimates were made using regression equations previously developed for Montana. The resulting 100-year discharges are listed in tables; the discharges ranged from 260 to 53,200 cu ft/s in Glacier National Park and from 110 to 27,900 cu ft/s in Yellowstone National Park. (USGS)
W84-03849

FLOOD OF JUNE 15, 1981, IN GREAT BEND AND VICINITY, CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
R. W. Clement, and D. G. Johnson.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $1.50 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4123, 1982. 9 p, 2 Fig, 2 Tab, 1 Ref.

Descriptors: *Floods, Flood frequency, Precipitation excess, Flood damage, Indirect flood measurement, Great Bend, *Kansas.

Torrential precipitation, as much as 20 inches in 12 hours, resulted in unprecedented flooding on Dry Walnut Creek in southwestern Barton County, central Kansas. Runoff from the storm caused extensive flooding in the town of Great Bend on June 15, 1981. Estimates of total damages exceeded $42 million. Measurements of peak discharges made in the downstream part of the Dry Walnut Creek watershed were as much as 3 1/2 times the estimated magnitude of the 100-year flood and in some locations exceeded the maximum previously measured discharge for the area. (USGS)
W84-03855

MUDFLOW HAZARDS ALONG THE TOUTLE AND COWLITZ RIVERS FROM A HYPOTHETICAL FAILURE OF SPIRIT LAKE BLOCKAGE,
Geological Survey, Tacoma, WA. Water Resources Div.
C. H. Swift, III, and D. L. Kresch.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $19.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4125, 1983. 20 p, 15 Fig, 2 Ref.

Descriptors: *Mudflows, Dam failure, *Flood inundation maps, *Washington State, Spirit Lake, *Mount St. Helens, Toutle River, Cowlitz River.

The debris avalanche accompanying the May 18, 1980, eruption of Mount St. Helens, in southwestern Washington, buried the former outlet of Spirit Lake, located 5 miles north of the volcano, to a depth ranging to 500 feet. Since that time, Spirit Lake has had no natural outlet and its lake level and contents have increased significantly. Erosion at the crest of the debris dam on the surface of the blockage and recent studies of the blockage stratig-

raphy and soil properties showing that the effective crest elevation is lower than the surface crest have led to concern that the lake may someday breach through or spill over the top of the blockage. A study was made by the U.S. Geological Survey to determine the extent of inundation that might result downstream in the Toutle and Cowlitz Rivers if a hypothetical breach should occur and generate a mudflow flood of catastrophic proportions. A hypothetical breach of Spirit Lake produced a hypothetical mudflow hydrograph with a peak discharge of 2.65 million cu ft/s and a sediment concentration of 65 percent by volume at Camp Baker on the North Fork Toutle River. Elevations determined by the hydraulic routing of the mudflow were used to prepare inundation maps, indicating depths of inundation to be about 60 feet at Castle Rock and Lexington; 30-40 feet at Toutle, Toutle Lake at Silver Lake, Kelson, and Longview; and 15-20 feet at Toledo. Travel times for the peak elevation were estimated to be about 15 hours to Kid Valley on the North Fork Toutle River, 21 hours to Castle Rock, 22 hours to Toledo, and 23 hours to Kelso and Longview on the Cowlitz River. (USGS)
W84-03856

INSTABILITY OF HYPERCONCENTRATED FLOW,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
F. Engelund, and W. Zhaohui.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 219-233, March, 1984. 13 Fig, 1 Tab, 5 Ref.

Descriptors: *Hyperconcentrated flow, *Flow characteristics, Flow, Flow profiles, Hydrodynamics, Mathematical models, Flood control, Flood plain management, River flow, Yellow River, China.

Volume concentrations of sediment as high as 35% have been recorded in the Yellow River and 56% in its tributaries. Such hyperconcentrated flow behaves quite differently from ordinary sediment-laden flow. The instability of hyperconcentrated flow observed in nature is reproducible in laboratory flumes using suspensions of bentonite. Similar instabilities are observed in a much simpler hydraulic system consisting of a container feeding a closed conduit. The behavior of two different clay suspensions, kaoline and bentonite, was investigated and the rheological properties were measured in a rotating viscosimeter. These non-Newtonian fluids are close to Bingham fluids, but deviate for small deformation rates. The instability is associated with some specific rheological properties. A simple mathematical model explains why the bentonite suspension was unstable at small discharges and stable at sufficiently large discharges. The kaoline suspensions were always stable. The agreement between calculations and observations is encouraging. (Murphy-IVI)
W84-03917

SYNTHETIC STREAMFLOW FORECAST GENERATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 277-289, March, 1984. 4 Fig, 14 Ref. OWRT grant B-080-WASH.

Descriptors: *Streamflow forecasting, Mathematical models, Simulation analysis, Optimum development plan, Algorithms, Skykomish River, Washington.

Simulation models have proven a durable and useful tool for the development of water resource system operating policies. One important component of any operating policy is streamflow forecasting. Incorporation of streamflow forecasts in a simulation model can be difficult because of the stochastic nature of forecasts and the range of forecast models in use. A forecast generation algorithm is developed which is applicable for any forecast model, and requires as input only the coefficient of prediction, a measure of forecast accuracy, and the first three moments of the forecast period flows. The algorithm uses a lag one Markov structure for forecast errors, where the correlation coefficient is a function of the forecast model coefficient of prediction. The generation algorithm is demonstrated for simulation of 7 and 120 day forecasts for the Skykomish River, Washington. (Author's abstract)
W84-03920

CYANAZINE LOSSES IN RUNOFF FROM NO-TILLAGE CORN IN 'LIVING' AND DEAD MULCHES VS. UNMULCHED, CONVENTIONAL TILLAGE,
Pennsylvania State Univ., University Park.
J. K. Hall, N. L. Hartwig, and L. D. Hoffman.
Journal of Environmental Quality, Vol. 13, No. 1, p 105-110, 1984. 8 Tab, 15 Ref.

Descriptors: *Cyanazine, *Agricultural runoff, *No-tillage, *Corn, Mulch, Tillage, Herbicides, Water pollution sources, Pennsylvania.

In recent years, significant increases in planting of no-tillage corn has stirred our interest in determining the impact of this tillage system and residue mulched soil surfaces in reducing both erosion and herbicide losses from sloping cropland. Reduction of herbicide losses is important, due to frequently increased use of herbicides in this type of land culture. Moreover, occasional reports claiming increased chloro-s-triazine herbicide contamination of surface waters from agricultural, nonpoint source pollution, targeted as excessive runoff from conventional- and even reduced-tillage-planted corn land, despite considerable data to the contrary, provided the impetus for further research in this area. Losses of cyanazine in runoff from untilled soil planted to corn (Zea mays L.) were compared with losses from conventionally planted corn on a 14% slope in the growing seasons of 1977 through 1979. The no-tillage systems consisted of corn planted into corn stover residue and into 'living mulches' of birdsfoot trefoil (Lotus corniculatus) and crownvetch (Coronilla varia L.). The no-tillage systems reduced runoff, erosion, and herbicide movement. For example, runoff from conventional tillage ranged from 5.5 to 22% of the runoff-producing rainfall. Soil loss from the same system ranged from 4.4 to 32.2 Mg/ha. On the other hand, runoff from the no-tillage systems ranged from 0.07 to 2.5% of the runoff-producing rainfall, while soil losses ranged from 0 to 1.1 Mg/ha. Transport of cyanazine in water runoff and entrained sediment from tilled areas totaled 257.0, 16.0, and 32.7 g/ha for the respective growing seasons, which represented 5.71, 0.73, and 1.48% of the amount applied yearly, 4.5 kg active ingredient (ai)/ha-1977; 2.2 kg ai/ha-1978, 1979. In the same years, cyanazine losses from no-tillage areas were 6.5-33.7 g/ha, 0.1-1.8 g/ha, and 1.6-3.3 g/ha at similarly applied rates. Collectively, these represented losses ranging from $<$ 0.01 to 0.75% of sprayed levels. Using conventional tillage as a reference treatment, untilled surfaces reduced runoff from 86.3 to 98.7%, soil losses from 96.7 to 100%, and cyanazine losses from 84.9 to 99.4% over the three growing seasons. In general, the 'living mulch' surfaces were more effective in retarding erosion than the corn stover residue surfaces. Corn grain yields were not significantly reduced by 'living mulches' when adequate legume suppression was obtained with herbicide treatments. (Murphy-IVI)
W84-03941

LONGITUDINAL DISPERSION IN A STREAM CALCULATED BY ONE DIMENSIONAL NUMERICAL MODEL,
Norsk Inst. for Vannforskning, Oslo.
T. Tjomsland.
Nordic Hydrology, Vol. 14, No. 1, p 41-46, 1983. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Stream flow, *Model studies, *Lena River, *Norway, Flow, Tracers, Solute transport, Path of pollutants.

Longitudinal dispersion is an important process relevant to pollution in natural water courses. In order to control contamination and predict levels of pollution in a strem the stream's capacity to transport and disperse must be known. A one-dimensional numerical model was used to simulate water stage and dispersion of matter in a 2-km reach of the river Lena, southeastern Norway. The mean gradient of the stream was about 1%. The bottom sediments consisted mainly of cobbles and gravel. The transport of the tracer was measured at four stations placed 0.3, 0.5, 1.2, and 2.5 km downstream from the injection point. Calculated results show quite good agreement with field measurements. (Baker-IVI)
W84-03975

DEVELOPMENT AND APPLICATION OF A STORAGE MODEL FOR RIVER FLOW FORECASTING,
Kobe Univ. (Japan). Dept. of Agricultural Engineering.
T. Hata, and M. G. Anderson.
Nordic Hydrology, Vol. 14, No. 3, p 139-154, 1983. 12 Fig, 1 Tab, 5 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, Floods, Prediction, Flood control, River flow, River Avon, England, River Kako, Japan.

A lumped sequential river flow forecasting model was developed which is flexible in both temporal and spatial scales, thus allowing simulations to be undertaken for a wide range of practical purposes. The method has some advantages compared with the discrete runoff analysis or direct runoff analysis method. One such advantage is the direct information about the storage of water in a river basin just before a storm which has a big influence on a flood runoff. The change from long-term simulation to short-term simulation and vice versa is easy in the current procedure because of the use of the same model with the same parameters. The required data input is very low and is restricted to topographic data for only small segments of the entire catchment. The model is successfully applied to the River Avon in England and the River Kako in Japan. (Baker-IVI)
W84-03983

FURROW IRRIGATION RUNOFF: A LINEAR SYSTEMS APPROACH,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. Sritharan, W. Clyma, and E. V. Richardson.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 29-42, March, 1983. 11 Fig, 6 Tab, 13 Ref, 3 Append.

Descriptors: *Furrow irrigation, *Runoff, Flood routing, Routing, Model studies, Unit hydrographs, Uniformity coefficient, Input-output analysis.

Runoff models for freely draining surface irrigation systems are mainly useful for the design of reuse systems and surface drainage systems. When a linear flood routing approach is taken for furrow irrigation runoff, the problem of delay in system response is confronted. This was dealt with by a constant response-variable delay linear model, and the corresponding input-output relationship was derived. This relationship of Duhamel Integral type was discretized, and an unconstrained least squares minimization procedure was used for the system identification for a set of furrow irrigation field data. After identifying a suitable delay function, the developed unit hydrographs were used in the interfurrow and interirrigation modes. Surface effects produced by clods and other nonuniformities existing in the furrows can cause considerable variation in the runoff prediction from the measured value. Uniformity in surface conditions is necessary for the successful application of the unit runoff hydrograph concept to furrow runoff prediction. (Murphy-IVI)
W84-04036

CENTRAL KANSAS FLASH FLOODS OF JUNE 1981,
National Weather Service Forecast Office, Topeka, KS.
L. W. Schultz.

Bulletin of the American Meterological Society, Vol. 65, No. 3, p 228-234, March, 1984. 5 Fig, 2 Ref.

Descriptors: *Flash floods, *Storms, *Kansas, *Flood forecasting, Great Bend, Hoisington, Soil water, Forecasting.

Two severe flash floods in central Kansas during June of 1981 were unusual as they occurred close together in time and space, only 8 days and 16 km apart. Terrain was not an important contributing factor to either flood. Moist soil that resulted from the first storm was apparently a significant contributor to the second flood. Forecasters should be alert to antecedent soil conditions. The maximum rainfall during the Hoisington storm washout was 185 mm which under normal circumstances would not have caused flooding. However, 100-150 mm of precipitation had fallen during the Great Bend storm only 8 days earlier. When moist soil conditions exist, considerably less rainfall is needed to produce flash flooding. The first, the Great Bend storm, developed during the afternoon and continued into the night, suggesting that daytime heating played a key role in initiating the convection. The Hoisington storm was a nocturnal event and occurred in the cooler air north of a stationary front with convection resulting from the flow of moist unstable air over the frontal zone. The moisture content of the atmosphere was very high for each event. The Great Bend and Hoisington storms had the general characteristics of the synoptic and frontal type floods, respectively. (Baker-IVI)
W84-04064

MAGNITUDE AND MODELLING OF SNOWMELT RUNOFF IN THE CAIRNGORM MOUNTAINS, SCOTLAND,

Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.

Hydrological Sciences Journal, Vol. 29, No. 1, p 49-62, 1984. 6 Fig, 3 Tab, 14 Ref.

Descriptors: *Snowmelt, *Runoff, *Scotland, *Cairngorm Mountains, *River Feshie, Model studies, Streamflow, Seasonal variations, Precipitation, Snowpack.

The Feshie is a right-bank tributary of the Spey draining the western edge of the Cairngorm mountains in Scotland. Streamflow in the River Feshie (106 sq km) shows persistent diurnal oscillations from March to June. Runoff in the study area is dominated by snowmelt in the spring months, with persistent diurnal oscillations reaching on one occasion >40 mm/d of meltwater production averaged over the snow or 23 mm/d over a 106-sq km basin. Daily discharges during the melt season can successfully be simulated from crude meteorological data by a simple lumped temperature-index method with built-in snowpack depletion. The three hydrometeorological parameters appear adequately stable from one year to the next and the model is less sensitive to these than to initial snowpack extent and water-equivalent thickness, which may vary greatly from year to year, and to errors caused by inadequate precipitation data. (Baker-IVI)
W84-04069

REGIONAL RELATIONSHIPS BETWEEN BASIN SIZE AND RUNOFF CHARACTERISTICS,

Athens Univ. (Greece). Dept. of Civil Engineering.
M. Mimikou.

Hydrological Sciences Journal, Vol. 29, No. 1, p 63-73, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Runoff, *Drainage basins, Watersheds, Rainfall-runoff relationships, Model studies, Flood control, Storms, Greece.

The maximum observed flood flow, the maximum annual constant loss, the lag time and the unitgraph peak for a certain storm duration for basins in the western and northwestern regions of Greece are increasing power functions of basin size. These functions explain the variation in the analyzed runoff characteristics. The maximum observed floodflow, the maximum annual constant loss, the lag time and the unitgraph peak for a certain storm duration for these basins are increasing power functions of basin size. For both regions single relationships are derived for the lag time and the unitgraph peak, whereas for the observed floodflow and the maximum annual constant loss they vary regionally with the climatic conditions. Care is needed in transferring regional relationships, like the ones in this study outside the immediate range and location of their derivation as they may be regionally varying. The transferability of their parameter values is also doubtful. The derived regional relationships can be used in accurately predicting design flood flows, annual runoff yields and unitgraphs of various storm durations for ungauged basins in the regions studied, needed for the hydrological design of various water resources development systems. (Baker-IVI)
W84-04070

AREAL PREDICTION OF ANNUAL FLOODS GENERATED BY TWO DISTINCT PROCESSES,

McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M.-K. Woo, and P. R. Waylen.

Hydrological Sciences Journal, Vol. 29, No. 1, p 75-88, 1984. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Floods, *Prediction, Flood frequency, Gumbel distribution, Drainage basins, Mathematical equations, Snowmelt, Rainfall.

The compounded Gumbel distribution provides a good description of flood frequency in areas where the annual peak flows are produced by both snowmelt and rainfall. The spatial variation of the flood generating processes can be represented by trend surfaces fitted to the compounded Gumbel parameters. A combination of the spatial interpolation of the parameter values from the trend surface equations and an expansion of a given equation provides a tool to establish the various probabilities of annual floods for ungauged basins. Two tests were performed to demonstrate the usefulness of the proposed technique. The compounded distribution can apply not only to snowmelt and rainfall induced annual floods, but equally well to handle situations where floods are attributable to distinctive types of rainstorms, such as frontal rain and thunderstorm showers. Where the spatial variation of the distribution parameters is statistically summarized by trend surfaces, the probability distribution of annual floods can be predicted for ungauged streams. Thus the proposed method is applicable to different climatic regions and is practical for deriving flood frequencies for poorly gauged or ungauged basins in many isolated areas of the world. (Baker-IVI)
W84-04071

SPATIAL VARIABILITY OF RUNOFF,

Agricultural Research Service, Columbia, MO. North Central Watershed Research Center.
A. T. Hjelmfelt, Jr., and R. E. Burwell.

Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 46-54, March, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Runoff, *Spatial variability, *Small watersheds, Simulation, Water retention, Model studies, Storm runoff, Variability, Confidence limits.

During the spring and summer of 1981, 40 adjacent runoff-erosion plots (each 27.4 x 3.2 m) were maintained in a fallow condition. Twenty-six rainfall events occurred that produced runoff during this period. The array of plots simulate an intensively sampled watershed of field size, so the results are analyzed to describe spatial variation of runoff and water retention. The coefficient of variation for individual events in which all plots exhibited runoff ranged from 0.65-0.07. Individual plots did not react consistently throughout the series of storms, but were seen to shift between producing more and less than the average volume of runoff. In the usual descriptions applied by current mathematical models of small watersheds, each plot was identical, so these results contribute to defining confidence limits that can be applied to model results, i.e., if a mathematical model were constructed that predicted the 40-plot mean for each event, and that model were compared with the observed values for any one plot, there would be differences between predicted and observed results. This study helps to establish the significance of that difference. (Moore-IVI)
W84-04093

PREDICTION OF PEAK FLOWS ON SMALL WATERSHEDS IN OREGON FOR USE IN CULVERT DESIGN,

Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
A. J. Campbell, and R. C. Sidle.

Water Resources Bulletin, Vol. 20, No. 1, p 9-14, February, 1984. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Flood peak, *Small watersheds, *Culverts, *Oregon, Roads, Forests, Flood frequency, Design criteria, Catchment areas, Precipitation, Elevation.

Using data from 80 Oregon watersheds that ranged in size from 0.54 sq km to 27.45 sq km, equations were developed to predict peak flows for use in culvert design on forest roads. Oregon was divided into six physiographic regions based on previous studies of flood frequency. In each region, data on annual peak flow from gaging stations with more than 20 years of record were analyzed using four flood frequency distributions: type 1 extremal, two parameter-log normal, three parameter-log normal, and log-Pearson type III. The log-Pearson type III distribution was found to be suitable for use in all regions of the State, based on the chi-square goodness-of-fit-test. Flood magnitudes having recurrence intervals of 10, 25, 50, and 100 years were related to physical and climatic characteristics of drainage basins by multiple regression. Drainage basin size was the most important variable in explaining the variation of flood peaks in all regions. Mean basin elevation and mean annual precipitation were also significantly related to flood peaks in two regions of western Oregon. The standard error of the estimate for the regression relationships ranged from 26 to 84%. (Author's abstract)
W84-04098

EFFECTS OF A MOVING RAINSTORM ON DIRECT RUNOFF PROPERTIES,

Department of Agriculture, Lethbridge (alberta). Research Station.
N. Foroud, R. S. Broughton, and G. L. Austin.

Water Resources Bulletin, Vol. 20, No. 1, p 87-91, February, 1984. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Rainfall-runoff relationships, *Flood flow, *Rainstorms, Flood hydrographs, Simulation, Mathematical models, Flood peak, Velocity, Moving rainstorms, Channel velocity.

The effects of a moving rainstorm on flood runoff characteristics were investigated. A flood hydrograph simulation model called 'FH-Model' and a natural watershed were used. A hypothetical rainstorm of 50 years recurrence interval, 75 mm depth, and 4 hours duration was used to show the effects of velocity and direction of the moving rainstorm on the runoff characteristics. Compared with an equivalent stationary rainstorm (ESRS), the peak flow caused by a rainstorm moving in a downstream direction with a speed equal to channel velocity, V, was 27.5% higher and the peak flow caused by the same rainstorm moving in an upstream direction was 21.7% smaller. These percentages reduced to 10.5% and 8.6% for storms moving downstream and upstream, respectively, at three times the channel velocity, 3V. There were negligible differences in the time of peak, Tp, between runoff caused by storms moving downstream and runoff produced by ESRS. However, Tp for a storm moving upstream at V velocity was 82% higher than that produced by ESRS, but was reduced to 27% higher when the storm velocity was 3V. (Author's abstract)
W84-04108

January. The soil moisture content on the north-facing site exceeded that of all other sites. The south-facing lower site was the driest, while the south-facing upper site and the ridge top were intermediate and had similar moisture regimes. It was concluded that the moisture regime of the south-facing lower site was a joined effect of aspect and relatively high stoniness. (Author's abstract)
W84-04129

SMALL-SCALE HETEROGENEITY AND SOIL-MOISTURE VARIABILITY IN THE UNSATURATED ZONE,
Toronto Univ. (Ontario). Dept. of Geography.
A. G. Price, and B. O. Bauer.
Journal of Hydrology, Vol. 70, No. 1-4, p 277-293, 1984. 9 Fig, 1 Tab, 30 Ref.

Descriptors: *Aeration zone, *Soil water, *Soil texture, Percolation, Soil hydraulics.

Soil moisture content was measured at seven location within the unsaturated zone of an instrumented swale using a subsurface moisture probe with a gauge scalar. The bulk of the data is from a 5 m long transect of five access tubes. Readings were taken at 0.1 m depth intervals starting at 0.2 m and extending to 2.3 m below the ground surface. Great variability in soil-water content exists in a soil mass of only 5.0-m length and 2.5-m depth. Surface-water inputs from snowmelt and runoff are spatially homogeneous throughout the basin, but interact with heterogenous soil to generate great complexity. Water which initially percolates vertically is differentially impeded as a result of subtle textural changes in the soil, and is then preferentially retained in such zones of transition, causing large differences in soil-water content to occur. The scale of this vertical variability is of tenths of meters, while lateral variability of soil moisture reflects textural changes over a few meters. The observed influence of small-scale heterogeneity on soil-water content suggests that the conventional assumptions of isotropicity and homogeneity of the textural and hydraulic properties of porous media used in drainage basin and hillslope hydrological models need scrutiny, even for single stratigraphic units. (Moore-IVI)
W84-04156

SOIL AND XYLEM WATER POTENTIAL AND SOIL WATER CONTENT IN CONTRASTING PINUS CONTORTA ECOSYSTEMS, SOUTH-EASTERN WYOMING, USA,
Wyoming Univ., Laramie. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W84-04175

SUBMERSIBLE PRESSURE OUTFLOW CELL FOR MEASUREMENT OF SOIL WATER RETENTION AND DIFFUSIVITY FROM 5 TO 95 DEGREES C,
Geological Survey, Menlo Park, CA.
J. Constantz, and W. N. Herkelrath.
Soil Science Society of America Journal, Vol. 48, No. 1, p 7-10, January-February, 1984. 3 Fig, 10 Ref.

Descriptors: *Pressure outflow cell, *Soil moisture retention, *Soil temperature, Soil water diffusivity, Hysteresis, Moisture content.

A technique was developed to measure water content in soil as a function of capillary pressure from 5 to 95 degrees C. To overcome problems encountered at high temperature, a modified Tempe pressure cell containing a soil sample is suspended in a constant-temperature water bath. The cell's porous plate is in direct contact with circulating bath water, thus eliminating the problem of entrapped air bubbles. A balance located above the water bath measures water content changes in the soil by weighing the entire pressure cell under water. The technique is designed to measure soil water retention characteristics and to make transient outflow estimates of the soil water diffusivity at temperatures from 5 to 95 degrees C. The technique was also used to determine the isobaric temperature dependence of water retention in soil. Results indicate that at constant capillary pressure, the relationship between moisture content and temperature is hysteretic. (Murphy-IVI)
W84-04180

SHAPE FACTORS FOR SEEPAGE INTO PITS,
Illinois Univ. at Urbana-Champaign. Agricultural Experiment Station.
C. W. Boast, and R. G. Langebartel.
Soil Science Society of America Journal, Vol. 48, No. 1, p 10-15, January-February, 1984. 3 Fig, 1 Tab, 17 Ref. Illinois Agric. Exp. Stn. project 15-0356.

Descriptors: *Shape factors, *Seepage, Seepage pits, Hydraulic conductivity, Water table, Auger hole, Soil water.

The Auger Hole method for measuring hydraulic conductivity of soil below a water table has generally been used with relatively thin auger holes. For cerain situations, however, especially for stony soils, the practicality of using broad, shallow pits has been explored. This technique is called the 'pit-bailing' method. In the field 'pit-bailing' method, saturated hydraulic conductivity below a water table is determined from the rate of rise of water in a pit. The relationship between the rate of rise and the soil hydraulic conductivity is expressed as a shape factor. Shape factors are presented here for pits with length/radius ratio ranging from 0 to 2, for pits ranging from empty to 0.9 full, and for impermeable-barrier and very permeable source lower boundary conditions at various distances below the pit. The calculated shape factors are extrapolated to the situation of a pit in an effectively infinitely deep uniform soil. Shape factors for pits of a given fullness with a source or a semi-infinite lower boundary condition are found to decrease and then increase as the length/radius ratio of the bit increases, reaching a minimum typically when this ratio is between 0.2 and 0.5 for the semi-infinite case. This trend is investigated to determine whether it is due to calculation errors for extreme geometries or is due to real phenomena. That the trend exists is found by examining analytical solutions to two situations - a pit fully penetrating to an impermeable barrier and a disk in semi-infinite space. (Murphy-IVI)
W84-04181

STATISTICAL ANALYSIS OF SALINITY AND TEXTURE EFFECTS ON SPATIAL VARIABILITY OF SOIL HYDRAULIC CONDUCTIVITY,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Physics.
E. Bresler, G. Dagan, R. J. Wagenet, and A. Laufer.
Soil Science Society of America Journal, Vol. 48, No. 1, p 16-25, January-February, 1984. 3 Fig, 6 Tab, 27 Ref.

Descriptors: *Soil hydraulic conductivity, *Salinity, *Soil texture, Statistical analysis, Soil properties, Hydraulic conductivity, Soil saturation, Saline soils, Semivariogram, Covariogram, Multiple regression.

Managing water to optimize crop production is dependent on soil properties that affect the ability of the soil to trasmit water and salts. A statistical analysis that identifies the dominant factors responsible for the spatial variability of the saturated conductivity (Ks) in a selected field is presented. The variables are considered random functions of the space coordinates. Two types of stationarity are investigated: a constant mean and stationary variogram (stationarity of order 2) and trend of the means (nonstationarity of the mathematical expectation) with stationary covariances. Linear models of statistical dependence were used. Elimination of factors of minor importance was based on correlation analysis. Electrical conductivity (EC) and percent sand were the most important independent variables, whereas Ks, was the dependent variable. The analysis showed that soil salinity (EC) accounted for only 10 to 15% of the variability of Ks, texture (percent sand) explained 25 to 45% of the Ks variability, and 10 to 15% of the variability was explained by the interaction between salinity and texture. Various soil factors other than salinity and texture accounted for 30 to 50% of the variability in Ks. Semivariograms and covariograms of KsEC, and percent sand did not have a sill because of a significant horizontal linear trend. Calculations showed that the trend accounted for a about a half of the variability of the original data. Semivariograms and covarigrams of a new population of residuals after extracting the trend gave values of the sills equal to the variances. The integral scale of the residuals of Ks and percent sand was estimated to be about 15 to 20 m, whereas salinity (EC) did not display a spatial structure. The results can be generalized for other studies with different values of variances and covariances of soil salinity and soil texture. (Murphy-IVI)
W84-04182

ENHANCEMENT OF THERMAL WATER VAPOR DIFFUSION IN SOIL,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
A. Cass, G. S. Campbell, and T. L. Jones.
Soil Science Society of America Journal, Vol. 48, No. 1, p 25-32, January-February, 1984. 5 Fig, 3 Tab, 31 Ref. Dept. of Energy contract DE-AC06-76RL0 1830.

Descriptors: *Water vapor diffusion, *Water vapor, Temperature gradient, Thermal conductivity, Model studies, Evapotranspiration, Soil water, Soil properties, Soil Temperature, Moisture content, Mechanistic enhancement factor, Phenomenological enhancement factor, Nonisothermal diffusion.

Theories based on 'simple' adaptations of Fick's Law of diffusion do not adequately describe thermally induced flow except for extremely dry soils. An accurate description of thermally induced water vapor flow is needed to understand flow processes associated with evaporation from bare soil, groundwater recharge in the presence of deep geothermal gradients and heat loss from shallow aquifers used to store thermal energy. The enhancement of water vapor diffusion in soil resulting from a temperature gradient was determined using a transient state thermal conductivity measurement. A method was adapted for this study to allow measurement of the thermal conductivity as a function of temperature, water content, and pressure. The data allowed separation of thermal conductivity from thermally induced latent heat transport. Both the mechanistic enhancement factor eta of Philip and de Vries and the phenomenological enhancement factor beta of Cary are calculated from the slope of the relationship between thermal conductivity and reciprocal relative pressure. The enhancement factor, eta approaches 1 for dry soil and increases rapidly to values around 10 for a sand and a silt loam at water contents above half saturation and temperatures about 22 degrees C. At high water content and 3.5 degrees C, eta increased to 15. The inflection point water content for the eta vs. saturation curve was about twice as high in silt loam as in sand. Measurements conform well to the pattern predicted by a theoretical examination of enhancement factor behavior. Experimental results were also compared with two recent quantitative models of beta. These model predictions did not agree with measured values, nor did they conform to the theoretical limits of beta derived in this paper except at intermediate saturation and temperature values. (Murphy-IVI)
W84-04183

EFFECT OF PH ON SATURATED HYDRAULIC CONDUCTIVITY AND SOIL DISPERSION,
Agricultural Research Service, Riverside, CA. Salinity Lab.
D. L. Suarez, J. D. Rhoades, R. Lavado, and C. M. Grieve.
Soil Science Society of America Journal, Vol. 48, No. 1, p 50-55, January-February, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Hydrogen ion concentration, *Hydraulic conductivity, *Soil dispersion, Soil saturation, Soil water, Soil dispersants, Sodium adsorption rate, Electrolytes.

The adverse effects of exchangeable sodium on soil hydraulic conductivity (K) are well known, but at present only sodicity and total electrolyte concentration are used in evaluating irrigation water suitability. In arid areas, high sodicity is often associated with high dissolved carbonate and thus high pH, but in human areas high sodicity may be associated with low pH. To evaluate the effect of pH (as an indepedent variable) on K, solutions with the same SAR and electrolyte level were prepared at pH 6, 7, 8, and 9. Saturated K values were determined at constant flux in columns packed at a bulk density of 1.5 Mg cu m. At pH 9, saturated K values were lower than at pH 6 for a montmorillonitic and a kaolinitic soil. For a vermiculitic soil with lower organic carbon and higher silt content, pH changes did not cause large K differences. Decreases in K were not reversible on application of waters with higher electrolyte levels. The results from the K experiments were generally consistent with optical transmission measurements of dispersion. Although anion adsorption was at or below detection limits and cation exchange capacity (CEC) was only slightly dependent on pH, differences in pH effects on K among soils are likely due to differences in quantities of variable-charge minerals are organic matter. (Author's abstract)
W84-04184

DIVISION S-5-SOIL GENESIS, MORPHOLOGY, AND CLASSIFICATION, MOISTURE REGIMES AND MORPHOLOGICAL CHARACTERISTICS IN A HYDROSEQUENCE IN CENTRAL MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Plant and Soil Sciences.
E. W. Pickering, and P. L. M. Veneman.
Soil Science Society of America Journal, Vol. 48, No. 1, p 113-118, January-February, 1984. 4 Fig, 25 Ref.

Descriptors: *Soil mottling, *Soil classification, Soil saturation, Soil water, Soil properties, Soil temperature, Soil water table, Water table, Water table fluctuations.

Characterization of mottling phenomena frequently is a requisite for soil classification and soil survey interpretation. The absence, presence, and nature of mottles have become a key morphological feature for the inference of soil drainage conditions as it is often impractical to measure the soil moisture regime directly through long-term monitoring. Moisture regimes and associated soil mottling patterns were investigated over a 2-yr period in a Paxton-Ridgebury-Scarboro hydrosequence in central Massachusetts. Changes in physical conditions in these coarse-loamy fragipan soils were monitored with well points, tensiometers, soil temperature probes, and redox potential electrodes. Well-drained soils appeared uniformly brown, reflective of a generally strongly oxidized environment. They also showed the greatest seasonal fluctuations in soil temperature ranging from 0 to 23 degrees C. Matrix colors of highest chromas (6 or higher) occurred in the moderately well-drained (MWD) soils where reducing and oxidizing environments coexist within the profile at some time during the growing season. Prominent ferrans and albans in the 2Cx horizons of MWD soils were related to sustained groundwater levels, although higher water tables often occurred for periods too short or too cold for development of strongly reducing conditions. The characteristics grey streaking patterns of fragipans were best expressed in the 2Cx horizons of MWD soils and can be attributed to reducing environments during periods with soil temperature above biologic zero when conditions are wet but unsaturated. Significant translocation and leaching of iron occurred in the somewhat poorly drained soils, as evidenced by olive-grey matrix colors. Channel neoferrans and some neoalbans indicated that a reducing environment may persist within the B2 horizon long after it has become unsaturated. Lowest chroma colors in this hydrosequence was found in the very poorly drained soils where perennial conditions of saturation or near saturation exists up to the soil surface resulting in the strongest reducing environment and least fluctations in seasonal temperatures. (Murphy-IVI)
W84-04185

ANALYSIS OF LONG-TERM WATER TABLE DEPTH RECORDS FROM A HYDROSEQUENCE OF SOILS IN CENTRAL OHIO,
Ohio State Univ., Columbus. Dept. of Agronomy.
T. M. Zobeck, and A. Ritchie, Jr.
Soil Science Society of American Journal, Vol. 48, No. 1, p 119-125, January-February, 1984. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Water table depth, *Soil water table, Groundwater, Groundwater level, Drainage, Ohio.

Water table depth is a dynamic soil feature that fluctuates greatly from year to year and throughout the year when measured in the same soil series as well as between soils of different series. Water table depths and precipitation were measured over a 10-yr period on four adjacent forested soils in central Ohio. The soils included a hydrosequence of well, moderately well, poorly, and very poorly drained fine-textured soils. Graphs describing the probability of observing water tables during consecutive 2-week (semi-monthly) intervals, by soil depth class, were compared with estimates reported on USDA-Soil Conservation Service forms SOIL-SOI-5 and a method proposed in the Soil Survey Manual. All soils had a probability of an observed water table within 50 cm of the soil surface. Water tables were observed in all soils, with the exception of the well drained soil, within 25 cm of the surface, 10% of the time or more, over a 12- or 14-week period in the late winter and spring. (Murphy-IVI)
W84-04186

2H. Lakes

LIMNOLOGICAL STUDIES IN LAKE VILLARRICA. MORPHOMETRIC, PHYSICAL, CHEMICAL, PLANKTONICAL FACTORS AND PRIMARY PRODUCTIVITY,
Universidad Austral de Chile, Valdivia.
H. Campos, W. Steffen, C. Roman, L. Zuniga, and G. Aguero.
Archiv fur Hydrobiologie, Suppl. 65, No. 4, p 371-406, December, 1983. 15 Fig, 5 Tab, 40 Ref.

Descriptors: *Oligotrophic lakes, *Limnology, *Lake Villarrica, *Chile, Chemical analysis, Plankton, Primary productivity, Physical properties, Morphometry, Phytoplankton, Trancura River, Nutrients, Seasonal variation.

Lake Villarrica is located in a pre-andean mountain range at 230 m above sea level. The lake is oligotrophic, monomictic, and temperate with winter circulation and summer stratification. Its main physical and chemical parameters were studied during a year. The same data were simultaneously obtained in its principal affluent, the Trancura river, which is an important supplier of nutrients to the lake. The phytoplankton was analyzed qualitatively and quantitatively with its seasonal variations in the water column. The diatoms are dominant in autumn-winter, and the Myxophyceae and Chlorophyceae in spring-summer. The pattern of annual variation of phytoplanktonic density coincides with that of chlorophyll-a and primary productivity. The maximum productivity was registered in summer. The zooplankton was analyzed qualitatively and quantitatively with its seasonal variations that follow the pattern of the phytoplankton density. Lake Villarrica seems to maintain its oligotrophy because of its morphometric constitution, seasonal variation regulated mainly by the temperature, limited input of nutrients from its affluents, seasonal phytoplankton variation with different communities (spring and summer) responsible for the greater productivity, and variation of the zooplankton density according to the phytoplankton density. (Baker-IVI)
W84-03505

ARE CHANGES IN PHYTOPLANKTON ASSEMBLAGES OF PIBURGER SEE CONSEQUENCES OF HYPOLIMNETIC WATER REMOVAL (SIND DIE VERANDERUNGEN IM PHYTOPLANKTONBILD DES PIBURGER SEES AUSWIRKUNGEN DER TIEFENWASSERABLEITUNG),
Innsbruck Univ. (Austria). Botanisches Inst.
For primary bibliographic entry see Field 5G.
W84-03507

TEMPORAL VARIATION IN ALGAL BIOASSAYS OF WATER FROM TWO PRODUCTIVE LAKES,
Freshwater Biological Association, Windermere (England).
J. D. Box.
Archiv fur Hydrobiologie, Suppl. 67, No. 1, p 81-103, October, 1983. 6 Fig. 3 Tab, 59 Ref.

Descriptors: *Algal growth, *Bioassay, *Phosphorus, Dissolved organic matter, Iron, Microcystis, Blelham Tarn, Esthwaite Water, England.

Results of laboratory bioassays using Microcystis aeruginosa (Cyanophyta) carried out over a year on GF/C filtered water-samples from two productive lakes (Blelham Tarn and Esthwaite Water) in the English Lake District are presented. It was necessary to add EDTA or Fe(III)EDTA to demonstrate the phosphorus limitation which had been predicted from N:P ratios (atomic). The increased yield obtained at all times with added EDTA or FeEDTA suggested that iron was of major importance to the growth of the test alga. Unenriched and nutrient enriched water samples taken from both lakes during winter showed very low yields which may have been caused by the effects of trace metals. The ability of the water-samples from both lakes to support growth of the test alga was restored during the spring and a maximum yield was obtained during the summer when the ambient nutrient levels were low. It was not possible to separate the effects which the spring and summer phytoplankton populations could have had on the test alga - for instance, the stimulatory effect of the raised pH or the possible effects of the increased levels of dissolved organic material. (Baker-IVI)
W84-03508

BENTHIC ALGAE OF THE DANUBE IN THE NEIGHBOURHOOD OF VIENNA (DIE BENTHISCHEN ALGEN DER DONAU IM RAUM VON WIEN),
Biological Station, Lunz am See (Austria).
E. Kann.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 15-36, October 1983. 3 Tab, 73 Ref.

Descriptors: *Benthos, *Algae, *Danube River, Vienna, Austria, Water pollution effects, Wastewater.

The benthic algal biocoenosis (except diatoms) of the Danube to be found on embankment boulders, boats, pontoons and plants in the area of Vienna are described, with special reference to the influences of ecological factors, particularly sewage. The embankment boulders of the Danube are conspicuously green, owing mainly to epilithic chlorophytes, especially Cladophora. Diatoms are numerous. Often these algae are covered by detritus and then their development is hampered. On boats and pontoons there is a green belt of near-surface living algae such as Ulothrix, Cladophora and others. As epiphytes on algae and mosses, Chamaesiphon incrustans and diatoms prevail. The influences of the combined ecological factors are not clear in every case. The chemical factors and pH cause an algal flora known partially also from limestone streams. Influence of temperature or current could not be found. A zonation of the flora by the different water levels (high and low water) is not conspicuous. Light gradients are important on the lateral faces of stones. Sewage-pipe inflows are marked by tufts of Sphaerotilus and by an increase of green algae, especially Cladophora. Because of the broad ecological valence of the algae, it is not possible to classify them into distinct saprobity levels. Compared with other parts of the Danube some common species are found among the filamentous green algae and certain blue-green algae; but there are also important differences. (Baker-IVI)
W84-03510

ECOLOGICAL STUDIES ON THE PERIPHYTON PRODUCTIVITY IN THE RIVER LOISACH (PRODUKTIONSBIOLOGISCHE UNTERSUCHUNGEN AN DER LOISACH ANHAND VON AUFWUCHSMESSUNGEN),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
B. Wachs.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 77-99, October, 1983. 12 Fig, 7 Tab, 12 Ref.

Descriptors: *River Loisach, *Aquatic productivity, *Periphyton, River Isar, Lake Kochel, West Germany, Nutrients, Light intensity, Flow rate, Diatoms.

Periphyton was monitored regularly from 1979 to 1981 at three stations in the middle region of the River Loisach. The dominant periphyton species were identified: certain diatoms, Hydrurus foetidus, green and blue algae. A comparison of the averaged biomass with ecological conditions shows that in the outflow from the lake, production is two to three times greater than that in the river immediately above the lake. This maximum development of the periphyton biocoenosis is due to the high frequency of diatoms as well as to the stronger growth of the alga Hydrurus foetidus in the outflow. A clear seasonal preference was shown by the major species. The higher productivity in the lake outflow and the high fluctuations in the periphyton mass of this river region in contrast to those of the inflow are due mainly to physical factors, as the water of this river system is not below class II in quality. The most important ecofactors controlling periphyton development in the Loisach are the intensity of light and the rate of flow. (Baker-IVI)
W84-03512

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; I. GENERAL CHARACTERISTICS OF 42 LAKES AND THEIR PHOSPHOROUS LOAD. STUDY OBJECTIVES AND SCOPE,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
Z. Kajak, and B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 239-256, 1983. 3 Tab, 27 Ref.

Descriptors: *Lakes, *Eutrophication, *Phosphorus, *Poland, Drainage basins, Dimictic lakes, Polymictic lakes, Trophic level, Ecosystems, Water pollution sources.

General information is provided on complex studies conducted on 42 lakes (23 dimictic and 19 polymictic lakes) which are representatives for the lakelands in north-eastern Poland. The main objective was the characteristic of trophic state and the purity of lakes and a quantitative analysis of the main ecosystem components as a basis for determining characteristics and indices for lakes of various trophic state; the functioning of lake ecosystems depending on trophic state, pollution, and degree of mixing; and the rate of trophic state changes by comparing with data from other periods. At the study site sandy-loamy soils of an average permeability dominated. On the basis of the surface area of the drainage basin, the type of soil utilization, and the data on the amount and kind of sewage, and data on phosphorus export from land, the phosphorus load to lakes was estimated. Phosphorus load and also total phosphorus and nitrogen concentration in epilimnion in summer correlated positively with the density of river net in the drainage basin and with the ratio of surface area of the drainage basin to the surface area and volume of the lake. In 28 lakes also examined 15-29 years ago the visibility decreased, mainly in dimictic lakes. In some lakes the oxygen deficits in the hypolimnion were greater. The greater percent of dimictic lakes, where changes were observed as compared with the state some years ago, was undoubtedly due to the fact that the trophic status of these lakes was and is lower on the average than that of polymictic lakes, and thus more sensitive to the increasing load and concentration of nutrients. (Baker-IVI)
W84-03516

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; II. LAKE CATCHMENT AREAS - PHYSICO-GEOGRAPHICAL ENVIRONMENT. DESCRIPTION OF THE REGION AND 43 LAKES,
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
E. Bajkiewicz-Grabowska.
Ekologia Polska, Vol. 31, No. 2, p 257-286, 1983. 1 Fig, 8 Tab, 13 Ref.

Descriptors: *Lakes, *Limnology, *Poland, Nutrients, Precipitation, Lithology, Catchment areas, Climates, Drainage areas, Water pollution prevention, Soil, Land use, Geography.

A lake drainage area located in north-eastern Poland, mainly in the Masurian Lake District, was used to assess the effect of physico-geographical parameters on the removal and supply of nutrient matter to lakes. The annual precipitation totals range from 500 to 600 mm in this area of Poland, and only in the morainic-hill zone do they reach 600-700 mm. In assessing the effect of the catchment areas on the potential of nutrient matter supply to the lake several physico-geographical parameters of the catchment area were taken into account. These included some morphometric parameters such as the size of the catchment area directly included in the outflow, the average gradient of the catchment area, the river-network density, as well as the lithology, soil type and land use. Parameters relating the catchment area size to the size of the water body itself and to its water volume were also considered. The aggregate total of the characteristics made it possible to group the catchment areas into four classes which differ in their possibilities of removing matter, and in their rate of its supply to the water body. The classification indicates the parameters which to a medium and high degree affect the potential of nutrient matter supply. (Baker-IVI)
W84-03517

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; III. CHEMISTRY OF THE WATER IN 41 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 287-308, 1983. 3 Fig, 2 Tab, 21 Ref.

Descriptors: *Lakes, *Trophic level, *Poland, Eutrophication, Stratification, Phosphorus, Nitrogen, Nutrients, Seasonal variation, Ammonia, Magnesium, Dimictic lakes, Polymictic lakes.

Water chemistry was studied in 41 lakes in the north-eastern region of Poland. In each of the two types, dimictic and polymictic lakes, three lake groups were distinguished, differing in the content of phosphorous in the epilimnion. A comparison of variations in the content of chemical components in water during the growing season in the mictic type and their trophic groups indicates that an increase of trophic state of the lakes studied is characterized by: an increase in spring and summer concentration of phosphates, total organic and dissolved and particulate organic phosphorus; a growth of total organic, dissolved organic and particulate organic nitrogen; an increase in the content of ammonia in the surface and near-bottom water layers in both mictic types in spring, and an increase in the content of ammonia in the surface and near-bottom water layers in polymictic lakes in summer; a growth of the concentration of nitrates in both layers of dimictic lakes in spring; an increase in the content of calcium, potassium, bicarbonates, water oxidability and electrolytical conductivity in both layers and mictic types in spring and summer; and a growth of the content of magnesium in dimictic lakes. A high trophic state of lakes under the influence of pollution is indicated by high levels of total phosphorus and total nitrogen, summer concentration of ammonia and nitrites in the surface water layers of polymictic lakes; high summer content of ammonia at the bottom of dimictic lakes; high content of calcium, potassium, sodium, chlorides, sulfates, and carbonates; a high level of oxidability and electrolytic conductivity of water, but lower percentages of calcium and bicarbonates, at higher percentage of sodium, potassium and chlorides in the ion balance; high summer and spring concentration of phosphates, as well as their percentage in total phosphorus in the epilimnion. (Baker-IVI)
W84-03518

ECOLOGICAL AND CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; IV. CHEMISTRY OF BOTTOM SEDIMENTS IN 37 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 309-331, 1983. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Lake sediments, *Trophic levels, *Poland Nitrogen, Phosphorus, Bottom sediments, Organic matter, Seasonal variation, Chemical analysis, Dimictic lakes, Polymictic lakes.

Concentrations of organic matter, total, organic and mineral phosphorus, and of organic nitrogen were compared for bottom sediments in 37 lakes in north-eastern Poland. Studies were carried out during spring circulation and during summer stagnation. In dimictic lakes, the content of total phosphorus and total nitrogen in the near-bottom water layer increased in spring and summer together with the rising trophic state of the lakes. In bottom sediments the highest levels of total, organic and mineral phosphorus, of organic nitrogen and organic matter were found in lakes with the highest and those with the lowest trophic state. In dimictic lakes characterized by a high trophic state, the summer content of total phosphorus in the sediments was higher than the spring content. In other dimictic lakes the content of total phosphorus in sediments was lower in summer than in spring. Organic nitrogen in sediments increased in the summer in some dimictic lakes but decreased in others. In polymictic lakes, in spring and summer the content of total phosphorus in the near-bottom water layer increased. The content of total and organic phosphorus in the sediments of most polymictic lakes decreased in the summer, relative to the spring on an average of 23 and 26%. The bottom sediments of polymictic lakes did not differ much in respect to the content of organic nitrogen in spring. The content of organic nitrogen in the sediments of some lakes increased in summer on an average by 15%, relative to the spring level, whereas in the majority of lakes it decreased in the same period on an average by 15%, relative to the spring level. (Baker-IVI)
W84-03519

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; V. CHLOROPHYLL CONTENT AND VISIBILITY OF SECCHI'S DISC IN 46 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
B. Zdanowski.
Ekologia Polska, Vol. 31, No. 2, p 333-351, 1983. 2 Fig, 2 Tab, 26 Ref.

Descriptors: *Lakes, *Trophic level, *Visibility, *Chlorophyll, *Poland, Seasonal variation, Dimictic lakes, Polymictic lakes, Phosphorus, Nitrogen, Silicates, Secchi disks, Bottom sediments.

The lakes under study varied in their morphology, trophic state and degree of anthropogenic impact. For spring, significant positive correlations were found between content of total phosphorus in the epilimnion and chlorophyll. No such correlation was noted with total nitrogen or silicates. In summer, highly significant positive correlations were noted between concentration of total phosphorus and content of chlorophyll and less significant positive correlation was noted between content of total nitrogen and chlorophyll. No correlation was found with silicates. For spring and summer, highly significant negative correlation

was found between concentrations of chlorophyll and the visibility of Secchi's disc. Changes in the average content of total phosphorus and total nitrogen in lakes of both mictic types and in both periods were accompanied by a decrease of the weight ratio of nitrogen to phosphorus. In spring and summer, visibility decreased as the trophic state increased mainly in the dimictic lakes, while in the polymictic lakes it was clearly higher in the group of lakes of the highest trophic state. These findings confirm the view that an increase in the content of total phosphorus in the epilimnion of polymictic lakes is the result of its inputs from bottom sediments, and to a lesser extent of higher summer concentration of chlorophyll and lower visibiliy in these lakes. (Baker-IVI)
W84-03520

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VI. THE PHYTOPLANKTON OF 43 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
I. Spodniewska.
Ekologia Polska, Vol. 331, No. 2, p 353-381, 1983. 11 Tab, 13 Ref.

Descriptors: *Phytoplankton, *Lakes, *Trophic levels, *Poland, Biomass, Species diversity, Eutrophication, Dimictic lakes, Polymictic lakes.

The biomass and structure of spring and summer phytoplankton of 24 deep, dimictic lake and 19 shallow, polymictic lakes were analyzed. The differentiation of phytoplankton biomass in particular lakes was greater in summer than in spring, and greater in polymictic lakes than in dimictic ones. In spring, blooms were recorded in three dimictic lakes and in nine polymictic lakes. In summer, blooms were noted in 10 dimictic lakes and in 15 polymictic lakes. In spring the most intensive water blooms were noted in three polymictic lakes. All had total phosphorus concentrations above 100 micrograms/liter. Two were considerably polluted. In summer a phytoplankton biomass about 30 mg/liter was noted in 9 very fertile polymictic lakes. In spring the nanoplankton contributed considerably to the total biomass of algae, both in dimictic and polymictic lakes. In summer the contribution of nanoplankton to total phytoplankton biomass was smaller than in spring, especially low in the most fertile polymictic lakes. The blue-green algae dominated the plankton of more fertile lakes. Dinoflagellates dominated in less fertile dimictic lakes. (Baker-IVI)
W84-03521

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VII. VARIATIONS IN THE QUANTITATIVE AND QUALITATIVE STRUCTURE OF THE PELAGIC ZOOPLANKTON (ROTATORIA AND CRUSTACEA) IN 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Karabin.
Ekologia Polska, Vol. 31, No. 2, p 383-409, 1983. 6 Fig, 3 Tab, 32 Ref.

Descriptors: *Poland, *Trophic level, *Ecology, *Lakes, Eutrophication, Zooplankton, Rotatoria, Crustacea, Bioindicators, Water pollution effects.

First attempts to determine the relation between the trophic state of lakes and the zooplankton colonizing them have been based on a faunistic analysis, thus searching for a relation between the occurrence of a given species in the lake and the trophic state. The aim is to determine a comprehensive analysis of zooplankton structure (numbers, biomass, specific and group structure) and its changes together with increasing trophic state of lakes differing in morphometry and degree of pollution. Only changes in the numbers of Rotatoria are directly connected with the increasing trophic state in lakes. The biomass ratio of Cyclopoida and Cladocera increases at first with a trophic state increase, but tends to decrease again in extremely eutrophic lakes. Quantitative parameters of zooplankton structure undergo considerable fluctuations, independently of lake trophic state. (Murphy-IVI)
W84-03522

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTHERN-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; VIII. ROLE OF NUTRIENT REGENERATION BY PLANKTONIC ROTIFERS AND CRUSTACEANS IN 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
J. Ejsmont-Karabin.
Ekologia Polska, Vol. 31, No. 2, p 411-427, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Trophic levels, *Poland, *Lakes, *Ecology, Rotifers, Crustaceans, Nutrient removal, Cycling nutrients, Phosphorus, Phosphorus removal, Nitrogen, Nitrogen removal, Regeneration, Zooplankton, Eutrophication.

Lake eutrophication is a process leading to an increased pool of nutrients contained in a lake. If not expelled from an ecosystem permanently, these nutrients are recycled within it. The recycling consisting of rapid continual changes of their chemical forms. Analyses have been carried out of the rate of phosphorus and nitrogen regeneration by the zooplankton of 42 lakes representing a trophic and morphometric gradient. In unpolluted lakes, regardless of the type of mixis, an increase in total-P concentration was accompanied by a rise in the rate of P and N regeneration by the zooplankton, a reduction of the turnover time of P and a decrease in the value of the N:P ratio in excretion products. In polluted lakes no significant relationship has been found between the pool of P in the water and the rate of regeneration, but a considerable increase was found in the turnover time of P. Directional changes in the rate of P and N regeneration by the zooplankton, as well as a reduction of the N:P ratio, following an increase in the nutrient content of water bodies may play a significant role in changes in the value of primary production in the course of eutrophication. The cause of differences in the reaction of polluted water bodies to changes in the total-P concentration suggests that being limited by factors other than the trophic conditions, the zooplankton of such water bodies are unable to efficiently mineralize excess P input. (Murphy-IVI)
W84-03523

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT IX. THE MACROBENTHOS OF 44 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
R. J. Wisniewski, and K. Dusoge.
Ekologia Polska, Vol. 31, No. 2, p 429-457, 1983. 3 Fig, 7 Tab, 25 Ref.

Descriptors: *Dimictic lakes, *Polymictic lakes, *Water circulation, *Stagnant water, *Macrobenthos, Trophic level, Phosphorus, Poland, Ecology, Taxonomy.

During the spring circulation and summer stagnation the macrobenthos of 24 dimictic and 20 polymictic lakes has been investigated in order to estimate their trophic state and purity, and to analyze the main ecosystem components with regard to their significance as indicators of the trophic state. In the profundal of dimictic lakes in the density and biomass of macrobenthos (especially the burrowing forms) show a tendency to decrease when the trophic state increases. With the advancing trophic state and the increase in depth the benthic fauna has became less varied. This was followed by a significant negative correlation of Shannon's index of species diversity with the trophic state of lakes determined on the basis of Ptot concentration in the water of epilimnion. (Murphy-IVI)
W84-03524

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT XI. MEIOBENTHOS AND NEAR-BOTTOM MEIOFAUNA IN 20 LAKES,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
K. Prejs, and K. Papinska.
Ekologia Polska, Vol. 31, No. 2, p 477-493, 1983. 1 Fig, 8 Tab, 13 Ref.

Descriptors: *Dimictic lakes, *Trophic levels, *Meiobenthos, *Meiofauna, Lake eutrophication, Bottoms sedments, Crustaceans, Nematodes, Ecology, Poland.

The environmental changes occurring in the profundal are connected with eutrophication and result in the phenomenon of oxygen deficit in the hypolimnion maintained for gradually longer periods of time. This is reflective of the animals living there. Species that are sensitive to deteriorating oxygen conditions are replaced by more resistant forms. The objective is to determine the relationship between some regularities in the occurrence of meiofauna and the gradient of lake eutrophication. Composition, numbers, biomass and species differentiation of meiobenthos and meiofauna in near-bottom water were analyzed in 20 dimictic lakes of different gradient of eutrophication. The highest species diversity of near-bottom meiofauna, near-bottom Cyclopoida and Nematoda, was observed in lakes with the least advanced trophic state. The correlation between commonly used indices of the trophic state of lakes and the above mentioned meiofauna characteristics was significant. (Murphy-IVI)
W84-03525

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT XII. DEPENDENCE OF CHOSEN INDICES OF STRUCTURE AND FUNCTIONING OF ECOSYSTEMS ON TROPHIC STATUS AND MICTIC TYPE OF 42 LAKES,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
Z. Kajak.
Ekologia Polska, Vol. 31, No. 2, p 495-530, 1983. 4 Fig, 6 Tab, 22 Ref.

Descriptors: *Polymictic lakes, *Dimictic lakes, *Trophic level, Mixis, Ecosystems, Phosphorus, Phytoplankton, Biomass, Epilimnion, Zooplankton, Poland.

To compile the results of complex studies on 42 lakes representative for lakelands in north-eastern Poland it was necessary to include information on the characteristics of drainage basin, physical and chemical characteristics of lakes, phytoplankton, zooplankton and its role in phosphorus and nitrogen circulation, macrobenthos and meiobenthos. This allows a characterization of the structural and functional characters of their ecosystems according to their trophic status and mixis. Biomass of phytoplankton (mainly blue-green algae) and of rotifers increase to the highest phosphorus concentrations in polymictic lakes, and reach much higher values than in dimictic ones. As the trophic state (Measured by Ptot) increases the percentage of phosphate phosphorus in Ptot increases as well as total nitrogen concentration (while the N:P ratio decreases), chlorophyll concentration, biomass of phytoplankton and blue-green algae, the contribution of blue-green algae to phytoplankton biomass, efficiency of phosphorus utililzation by blue-green algae and of nitrogen phytoplankton, numbers and biomass of rotifers. But the number of crustaceans undergo very little changes. Polymictic lakes have a higher trophic state than dimictic ones, mainly because more nutrients are returned from the bottom sediments to the water. This increase is observed up to the highest phosphorus concentrations recorded, whereas in dimictic lakes the biomass becomes rather stable at mean concentrations. Thus the efficiency of phosphorus utilization by phytoplankton is better in polymictic lakes. Despite all the regularities connected with changes of total phosphorus concentration in epilimnion the scatter of values (around the mean) is very high for particular lakes. Not many species can be treated

as definite indicators of the trophic state. (Murphy-IVI)
W84-03526

HABITAT EXPLOITATION BY LARVAE OF AMPHIPSYCHE MERIDIANA (TRICHOPTERA: HYDROPSYCHIDAE) IN A JAVANESE LAKE OUTLET,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
P. J. Boon.
Freshwater Biology, Vol. 14, No. 1, p 1-12, February, 1984. 5 Fig, 2 Tab, 40 Ref.

Descriptors: *Dam screens, *Intake screens, *Trichopteran, *Population density, Population dynamics, Flow, Ecosystems, Insect behavior, Larvae, Tuntang River, Java.

Trichopteran populations below a dam on the River Tuntang (Central Java) and on intake screens above the dam consisted almost exclusively of Amphipsyche meridiana. Larvae on dam screens were in tightly packed aggregations, with greater densities in deeper water, and were predominantly fourth or fifth instars during the period of observation. Below the dam, 40% of larvae were in the first three instars. Larvae at the dam screens were heavier and yielded larger emerging adults which contained more eggs per female. Mean net mesh sizes of fifth instar larvae varied greatly from 34 X 26 micrometer to 125 X 106 micrometer with larger mesh size possibly being positively correlated with faster flow rates. The dinoflagellate Peridinium, commonly found in the guts of larvae below the dam, was virtually absent in dam screen larvae, possibly due to mesh size differences. The behavior of larvae in aggregations was observed in a laboratory flow channel. After experimental destruction of feeding nets, larvae immediately ingested silk prior to the construction of a new net. Nets were spun in a 'figure 8' fashion, and took between 11 and 30 min to complete. Stridulation between larvae occurred frequently and may be related to the defence of silk reserves within territories. (Murphy-IVI)
W84-03527

PRODUCTION OF A STREAM SHREDDER, PELTOPERLA MARIA (PLECOPTERA: PELTOPERLIDAE) IN DISTURBED AND UNDISTURBED HARDWOOD CATCHMENTS,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 5C.
W84-03528

MACROINVERTEBRATE-HABITAT RELATIONSHIPS IN THE RIVER TEIFI CATCHMENT AND THE SIGNIFICANCE TO CONSERVATION,
Welsh Water Authority, Powys (Wales).
R. A. Jenkins, K. R. Wade, and E. Pugh.
Freshwater Biology, Vol. 14, No. 1, p 23-42, February, 1984. 4 Fig, 7 Tab, 24 Ref.

Descriptors: *Macroinvertebrates, *Teifi River, *Catchment areas, *Conservation, Population density, Regression analysis, Habitats, Altitude, River width, Hydrogen ion concentration, Resource value.

A macroinvertebrate survey of various habitats (e.g. riffles, pools, tree roots) at sixteen sites in the Teifi catchment in September 1981 yielded 217 taxa excluding Hydracarina and Chironomidae. Sites with the greatest number of habitats were generally rich in taxa and supported the highest number of 'rare' species, the latter generally being associated with vegetation. However, species were not generally restricted to particular habitats although ecdyonurid mayflies predominated in riffles and one leptocerid caddisfly was principally collected from tree roots. Four groups of taxa which characterized three habitat groups were established using classification procedures and it was concluded that three habitat types (eroding, depositing and vegetation) should be sampled to describe adequately the macroinvertebrate fauna at each site. Three attributes (species richness, species rarity and site uniqueness) were used to establish the conservational value of each site; in general, the main river and one lowland tributary were of highest conservational signficance. Multiple regression analyses were used to establish significant relationships between the three attributes and environmental features such as number of habitats, altitude, river width, pH and total hardness. Such relationships may facilitate a rapid assessment of resources value without expensive biological survey. (Author's abstract)
W84-03529

BIOLOGY OF THE CATFISH CHRYSICHTHYS AURATUS (GEOFFORY) IN THE MAN-MADE TIGA LAKE IN NORTHERN NIGERIA,
Bayero Univ., Kano (Nigeria). Dept. of Biological Sciences.
M. G. De L. Sturm.
Freshwater Biology, Vol. 14, No. 1, p 43-51, February, 1984. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Catfish, *Tiga Lake, *Nigeria, Biological properties, Fish behavior, Artificial lakes, Population dynamics, Spawning.

A study was made of the biology of Chrysichthys auratus, a bottom-feeding omnivore, in Tiga Lake, a man-made lake in Northern Nigeria. Ripe females were present from April to September, coinciding with the hot season and rise in water level. First spawning took place at age II in females. No ripe males were found, and this was attributed to their spatial separation. Absolute fecundity was related to length and ranged from 327 to 1466 in forty-six females. Hyaline rings on the centra of lumbar vertebrae were counted to age 235 fish. The first ring is laid down at the end of the second year, after which the rings were formed annually, probably during the breeding season. The fish live for up to 6 years. There is a good fit of the growth curve to the von Bertalanffy equation. Growth is slow and a smaller maximum size is attained in the lake than in rivers. (Murphy-IVI)
W84-03530

ATP AS A BIOMASS INDICATOR IN EIGHT NORTH ISLAND LAKES, NEW ZEALAND,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
R. D. Pridmore, A. B. Cooper, and J. E. Hewitt.
Freshwater Biology, Vol. 14, No. 1, p 73-78, February, 1984. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Adenosine triphosphate, *Biomass, *Lakes, *New Zealand, Carbon, Surface water, Biological properties, Mathematical equations, Bioindicators.

The determination of microbial biomass is often an essential step in the understanding and quantification of biological processes in aquatic ecosystems. The relationship between microbial ATP and biomass-carbon in the near surface waters (0.5-5 m) of eight New Zealand lakes was studied to determine the constancy of the carbon:ATP ratio under natural growth conditions. Concentrations of microbial carbon were estimated indirectly from cell volume determinations. The carbon:ATP ratio remained reasonably constant (interquartile range 248-291, n = 50), except during periods of nitrogen/phosphorus deficiency when carbon:ATP ratios increased to values greater than 400. During periods of nitrogen/phosphorus sufficiency, corresponding estimates of microbial ATP and biomass-carbon were strongly correlated (r = 0.97, n = 47) and related by the equation carbon = (287 + or - 20) ATP-(22 + or - 41) where carbon and ATP are expressed in mg/cu m. From this relationship an average carbon:ATP ratio of 267 (SE = 5) was calculated. This ratio was not significantly affected by the relative proportions of bacterial and algal biomass in the surface water samples. However, because of the marked deviation of the carbon:ATP ratio during periods of nitrogen/phosphorus deficiency, the routine use of ATP as a biomass indicator is discouraged. (Murphy-IVI)
W84-03531

SEASONAL CHANGES IN THE CONCENTRATION AND COLOUR OF HUMIC SUBSTANCES IN SOME AQUATIC ENVIRONMENTS,
Laval Univ., Quebec. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W84-03532

FRESH WATERS OF SHETLAND: PHYSICAL AND MORPHOMETRIC CHARACTERISTICS OF LOCHS,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
D. G. George, and P. S. Maitland.
Freshwater Biology, Vol. 14, No. 1, p 95-107, February, 1984. 7 Fig, 5 Tab, 21 Ref.

Descriptors: *Fresh waters, *Shetland, *Physical properties, *Morphology, Lochs, Ecology, Climate, Geology, Retention time, Sedimentation, Scotland.

The Shetland Island group lies 150 km to the north of mainland Britain, and has recently been developed as a center for oil exploration and production activities in the northern North Sea. Surveys were intended to provide an information base for planning decisions related to industrial developments on the islands. Basic physical and morphometric data were taken for sixty-five lochs on the islands. The interrelations between loch dimensions are comparable to those recorded elsewhere in Scotland, but the smaller lochs on Shetland tend to be somewhat shallower, and the large lochs somewhat deeper than usual. The flat bottomed nature of the small peaty pools presumably reflects the topographical processes involved in the formation and erosion of blanket peat. The greater depth of the larger stony basins, however, implies that the rate of sediment accumulation is fairly low. The streams draining into the lochs are often rich in allochthonous material since strong winds and driving rain cause rapid soil erosion on exposed slopes when vegetation is sparse. The results of a multivariate analysis show that most of the physical variables measured in the field are closely correlated with easily measured map attributes. (Murphy-IVI)
W84-03533

DIGEST OF WATER QUALITY OF THREE CENTRAL ILLINOIS IMPOUNDMENTS,
Illinois State Water Survey, Peoria. Water Quality Section.
S. D. Lin, and R. L. Evans.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 1 and 2, p 277-280, 1983. 1 Tab, 2 Ref.

Descriptors: *Water quality, *Illinois, *Impoundments, Canton Lake, Decatur Lake, Eureka Lake, Transparency, Water temperature, Dissolved oxygen, Turbidty, Hydrogen ion concentration, Alkalinity, Ammonia, Nitrogen compounds, Phosphorus compounds, Iron, Manganese, Sulfate, Chlorine demand, Chemical oxygen demand, Total organic carbon, Silica, Threshold odor number, Algae, Actinomycetes, Standard plate count.

Samples from Lakes Canton, Decatur, and Eureka were collected weekly for over 2 years and were analyzed for 22 parameters. These parameters are transparency, water temperature, dissolved oxygen (DO), turbidity, pH, alkalinity, hardness, ammonia and nitrate nitrogen, dissolved and total phosphorus, iron, manganese, sulfate, chlorine demand, chemical oxygen demand (COD), total organic carbon (TOC), silica, threshold odor number (TON), algae, standard plate count (SPC), and actinomycetes. The transparency in Lake Canton was generally greater than that in Lakes Eureka and Decatur. The temperature stratification barrier for L. Canton and L. Eureka occurred at 12 to 14 feet and 4 to 10 feet, respectively, for about six months every year from mid-April to mid-October. The thermal stratification of the lakes was not a barrier to the anaerobic zone penetrating the overlying waters. In general, except during the summer stagnation periods, hardness, COD, and TOC in all lakes did not change in water column. In L. Decatur concentrations of pH, alkalinity, nitrate, sulfate, chlorine demand, and silica did not change on the

vertical. At the surface and mid-depth of L. Canton and L. Eureka, the turbidity, alkalinity, nitrate nitrogen, and sulfate concentrations were not significantly different. The magnitude of taste and odor in the three lakes was found to be a seasonal function. Water temperature and sulfate concentrations in the three lakes were well within the IPCB limits. Most of the water quality parameters exhibited no seasonal or yearly variation. There was no correlation between parameters except for TON vs. nitrate, sulfate, manganese, and chlorine demand. Much of these inter-reactions are still unknown. Thus, modeling a complicated natural system should be discouraged until the nature and rates of interactions are better defined. (Murphy-IVI)
W84-03547

OCCURRENCE OF OECETIS INCONSPICUA (WALKER) IN AN ACID STRIP-MINE LAKE OF SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
S. Zullo, and N. Bates.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 3 and 4, p 293-296, 1983. 2 Tab, 21 Ref.

Descriptors: *Trichoptera, *Strip mine lakes, *Acidic water, *Illinois, Hydrogen ion concentration, Species composition, Aquatic habitats.

This study reports for the first time the finding of Oecetis inconspicua (Walker) in an acid-strip mine lake of southern Illinois. The caddisfly larvae and pupae were found among Typha latfolia detritus in less than one meter of water. Chemical composition of the surrounding water is typically rich in dissolved ions. The pH is around 3.2. Total dissolved solids concentration approaches 2450 mg/l. Species identification is important in all studies, but perhaps it is even more important in studies in acid strip-mine lakes because habitat conditions are vital to the species able to survive there. (Murphy-IVI)
W84-03548

WORK ENERGY IN A FINAL-CUT STRIP MINE LAKE IN SOUTHERN ILLINOIS,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
M. J. Chimney.
Transactions of the Illinois State Academy of Science, Vol. 76, No. 1 and 2, p 297-303, 1983. 4 Tab, 20 Ref.

Descriptors: *Work energy, *Strip mine lake, *Illinois, Birgean Work, Schmidt Stability, Total Direct Work, Moroni's Big Lake, Mathematical studies.

Calculation of the work parameters provides useful comparative data on the lacustrine energy dynamics within a lake. The work parameters: Birgean Work (B), Schmidt Stability (S), and Total Direct Work (G), were calculated for a final-cut strip mine impoundment located in southern Illinois using density data compensated for 1) temperature (= uncorrected work parameters: B, S, G) and 2) temperature, pressure, and salinity (= corrected work parameters: B', S', G'). Maximum work energies ocurred after the summer solstice and were comparable to levels observed in similar holomictic lakes. In general, $B' < B$, $S' > S$, and $G' < G$; These differences were attributed mainly to salinity; pressure was less important. Corresponding corrected and uncorrected work parameters were highly correlated with, and at the same time statistically different from, each other. Only differences between B' and B were regarded as limnologically significant however. (Murphy-IVI)
W84-03549

INITIAL ASSESSMENT OF TIME OF TRAVEL AND MIXING THROUGH GULF ISLAND POND AND THE LOWER ANDROSCOGGIN RIVER, MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03552

WATER QUALITY OF SOMERVILLE LAKE, SOUTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
E. McPherson, and H. B. Mendieta.
USGS Water-Resources Investigations Report 82-4124, 1983. 88 p, 20 Fig, 17 Tab, 25 Ref.

Descriptors: *Water quality, Surface water, Dissolved oxygen, Iron, Manganese, Nitrogen, Phosphorus, Dissolved solids, Chloride, Sulfate, Hardness, *Texas, Somerville Lake.

Lake Somerville in south-central Texas has excellent water for municipal, industrial, and agricultural use. The total dissolved solids of the water averaged 220 milligrams per liter during a study from 1975-80. This shallow lake has a mean depth of 14 feet. The average annual inflow and discharge is greater than the volume of the lake. These two factors, along with wind action and the cooling of surface water during both summer and winter keep the lake well mixed and aerated. Even in summer the dissolved oxygen concentrations at the bottom of the lake usually were in excess of 50 percent of saturation. Dissolved iron concentrations are less than 50 micrograms per liter and dissolved manganese concentrations are under 40 micrograms per liter. These small concentrations are largely attributable to year-round oxygenated water. Homogeneous or near homogeneous concentrations of total phosphorus and inorganic nitrogen can occur at any time of the year throughout the lake. Dissolved chloride concentrations averaged 43 milligrams per liter and dissolved sulfate concentrations averaged 63 milligrams per liter. The total hardness of the water averaged about 110 milligrams per liter, placing it in the moderately hard classfication. (USGS)
W84-03583

WATER QUALITY OF LAKES FAITH, HOPE, CHARITY, AND LUCIEN, 1971-79, IN AN AREA OF RESIDENTIAL DEVELOPMENT AND HIGHWAY CONSTRUCTION AT MAITLAND, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
E. R. German.
USGS Water-Resources Investigations Report 82-51, 1983. 71 p, 18 Fig, 18 Tab, 14 Ref.

Descriptors: *Water quality, *Lakes, Runoff, Precipitation, *Florida, Orange County, Seminole County, Maitland.

Lakes Faith, Hope, and Charity were sampled from April 1971 to June 1979 to monitor water quality before, during, and after construction of Maitland Boulevard and the Interstate Highway 4 interchange. Lake Lucien was added to the study in April 1975. Chemical quality of the lakes varies little in comparison with surface runoff, bulk precipitation, and the water in the surficial aquifer. Surface runoff supplied about 19 percent of the direct inflow to the lakes and contributed a total of about 2,000 pounds, per acre of lake surface, of dissolved solids from April 1971 to June 1979, while bulk precipitation contributed about 1,170 pounds per acre. Water quality in the lakes changed during the study, generally for the better. However, an infestation of elodea (Hydrilla verticillata), whose growth is not associated with water quality, developed in Lake Hope near the end of the study and has interfered with recreational use of the lake. (USGS)
W84-03596

RELATIONSHIP BETWEEN LAKE TROPHIC LEVEL AND LAKE SEDIMENTS,
National Swedish Environment Protection Board, Uppsala (Sweden). Water Quality Lab.
L. Hakanson.
Water Research, Vol. 18, No. 3, p 303-314, 1984. 4 Fig, 8 Tab, 64 Ref.

Descriptors: *Lake sediments, *Trophic level, Nutrients, Phosphorus, Carbon, Nitrogen, Chlorophyll, Transparency, Sedimentation, Lakes.

The relationship between lake type, as expressed by various trophic characteristics, and sediment type, as expressed by determinations of simple chemical data on nitrogen, phosphorus, carbon and loss on ignition was studied. A BPN-value (bioproduction number), defined by the slope coefficient of the regression line between N-content and IG-content of surficial sediments provides most accurate information about lake trophic level on the scale from oligotrophy to eutrophy, provided that more than 50% of the lake area has lower loss on ignition than 20%. The BPN-value cannot be used as an indicator of trophic level if the IG-content is predominantly higher than 30% in a lake. In the latter case the ratio IG/N can be used as a means to differentiate lake humic level. The BPN-value, which is determined from sediment samples providing an even spread throughout the lake surface, yields lake typical information, whereas C/N rations yield site specific information. A diagrammatic interpretation between lake trophic type and lake sediments was developed. (Baker-IVI)
W84-03732

EFFECT OF OXYGEN CONCENTRATION ON THE RATES OF DENITRATIFICATION AND DENITRITIFICATION IN THE SEDIMENTS OF AN EUTROPHIC LAKE,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemical Engineering.
M. Nakajima, T. Hayamizu, and H. Nishimura.
Water Research, Vol. 18, No. 3, p 335-338, 1984. 5 Fig, 16 Ref.

Descriptors: *Denitritification, *Denitratification, *Lake sediments, *Eutrophic lakes, Oxygen demand, Sediments, Nitrates, Nitrites, Acetylene inhibition method.

The acetylene inhibition method was used during initial 1 hr incubation periods after preculture under complete anaerobic conditions to determine the effect of oxygen concentration on the rates of denitratification and denitritification for wide ranges of nitrate and nitrite concentrations. Sediment samples were collected for use from a highly eutrophic lake. A maximum denitratification rate of 4 micromol/hr was obtained under anaerobic conditions. The denitratification rate was a decreasing function of the oxygen concentration below 60 microM. About the same rate was noted for denitritification in the range below 30 microM oxygen. Beyond 30 microM oxygen, this rate dropped to half of the maximum, and remained almost constant until a critical oxygen concentration was obtained. The critical concentration above which denitritification was suppressed thoroughly, depended on nitrite concentration. The rates of denitritification and denitratification under anaerobic conditions increased approximately proportionally to the temperature between 5-30 C. The rate of denitritification was always higher than that of denitratification at each temperature under 160 microM nitrate or nitrite concentration. (Baker-IVI)
W84-03735

CONTRIBUTION TO THE PHYSICO-CHEMICAL LIMNOLOGY OF SWARTVLEI,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
For primary bibliographic entry see Field 2L.
W84-03744

EXTERNAL BUDGETS FOR PHOSPHORUS, NITROGEN AND DISSOLVED ORGANIC CARBON FOR THE ACIDIFIED LAKE GARDSJON,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
O. Broberg, and G. Persson.
Archiv fur Hydrobiologie, Vol. 99, No 2, p 160-175, January, 1984. 2 Fig, 5 Tab, 40 Ref.

Descriptors: *Limnology, *Oligotrophic lakes, *Nutrients, *Lake Gardsjon, Sweden, Phosphorus, Nitrogen, Dissolved solids, Acidification, Acid rain.

Lake Gardsjon is situated in an area with thin moraines and difficultly weathered rocks where

lakes have been acidified during recent decades due to acid rain. A residence time of water in the lake is 1.0 yr. Deposition on the lake surface is the largest source of phosphorus and nitrogen, but the surrounding land contributes most of the dissolved organic carbon (DOC) entering the lake. Precipitation in forested areas is further enriched in phosphorus and DOC during the passage through the canopy. Phosphorus is effectively trapped within the soil profile, probably through adsorbtion to aluminum and possibly to iron. Retention in Lake Gardsjon is low for phosphorus compared to mesotrophic and eutrophic lakes but may not largely differ from other oligotrophic lakes. DOC is effectively broken down or precipitated within the lake, causing a high transparency. The possible carrier function of humic substances for nitrogen and phosphorus is of less importance in this lake than in brownwater lakes. (Baker-IVI)
W84-03745

INVERTEBRATE FAUNA OF A SMALL CHALK STREAM IN BERKSHIRE, ENGLAND, AND THE EFFECT OF INTERMITTENT FLOW,
Freshwater Biological Association, Wareham (England). River Lab.
J. F. Wright, P. D. Hiley, D. A. Cooling, A. C. Cameron, and M. E. Wigham.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 176-199, January, 1984. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Intermittent streams, *Invertebrates, *England, *Winterbourne, Streams, Aquatic fauna, Stream flow, Species composition, Seasonal variation.

The invertebrate fauna of the Winterbourne, which has intermittent flow in its upper section, was examined for one year. An initial survey at 17 sites along the entire 8 km long stream in February was followed by a bimonthly survey at 10 downstream sites until December. The distribution of species was analyzed and related to the flow regime. A total of 233 taxa were recorded. Examination of the species lists for each site demonstrated a marked discontinuity in the distribution of many species around the perennial head. This feature was also highlighted using cluster analysis. Species which were restricted to either intermittent or perennial sites and which showed a high frequency of occurrence in the samples could therefore be of help in determining the location of the perennial head. A proposal that the fauna of temporary streams consists of three components (permanent stream species, facultative species and specialized species) was examined in light of the species reported for the intermittent sites in the Winterbourne. (Baker-IVI)
W84-03746

TRIBUTARIES AS MODIFIERS OF THE RIVER CONTINUUM CONCEPT: ANALYSIS BY POLAR ORDINATION AND REGRESSION MODELS,
Sam Houston State Univ., Huntsville, TX. Div. of Life Sciences.
D. A. Bruns, G.W. Minshall, C. E. Cushing, K. W. Cummins, and J. T. Brock.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 208-220, January, 1984. 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Benthic environment, *Rivers, *Tributaries, River Continuum Concept, Particulate matter, Salmon River, Idaho.

Data was collected on functional groups and organic matter parameters at sampling sites of differing stream size above, within, and below tributaries of the Middle Fork of the Salmon River, Idaho to discern tributary effects upon river continuum relationships. The composition of functional groups and benthic and combined organic matter parameters varied as significant functions of link magnitude in regression analyses both with and without data from tributary-affected sampling sites. The composition of transport based on data without tributary effects also varied as a function of stream size, but with tributary-affected sites included in the analysis, a statistically significant pattern was not evident. Transport seems to be more susceptible to tributary alteration. Tributaries most strongly modified river continuum patterns in regard to gathering collectors, predators, periphyton, and transported ultra-fine particulate organic matter ranging in size from 0.45 to 52 micrometers. Small tributaries seemed to set community development forward along the river gradient and large tributaries tended to set it back. (Baker-IVI)
W84-03748

MIGRATION PATTERNS OF FIVE FISH SPECIES IN THE MURRAY-DARLING RIVER SYSTEM,
South Australia Dept. of Agriculture, Adelaide.
L. F. Reynolds.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 6, p 857-871, 1984. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Fish migration, *Rivers, *Murray River, *Darling River, Australia, South Australia, Migration, Population dynamics, Fish behavior, Carp, Catfish, Perch.

Of 14,333 fish tagged in a study carried out in the Murray River, South Australia from 1974 to 1978, 1276 were recaptured. Some golden perch moved extensively upstream, many moving more than 1000 km. The migration followed, and appeared to be triggered by, a rise in water level at the onset of major flooding. The upstream migrations, made only by mature fish, appear to be a reproduction strategy to ensure that the eggs are distributed downstream. Common carp, which lay adhesive, demersal eggs, did not migrate but made only random, short distance movements. While data on other species were fewer it appears that Murray cod and catfish, both of which have demersal eggs, show similar movement patterns to carp whereas silver perch, which lays buoyant eggs, is similar to golden perch. Since catfish and Murray cod maintain popultions without undergoing major upstream spawning migrations, it can be supposed that purely local events such as overfishing, pollution, destruction of spawning areas by river channelization and desnagging could seriously depress or even destroy local populations. (Baker-IVI)
W84-03749

ABUNDANCE, BIOMASS AND DIVERSITY OF BENTHIC MACRO-INVERTEBRATES IN A WESTERN CAPE RIVER, SOUTH AFRICA,
Cape Town Univ. (South Africa). Percy Fitzpatrick Inst. of African Ornithology.
J. M. King.
Transactions of the Royal Society of South Africa, Vol. 45, Part 1, p 11-34, August, 1983. 3 Fig, 7 Tab, 32 Ref.

Descriptors: *Rivers, *Biomass, *Environmental effects, *Water resources development, South Africa, Invertebrates, Macroinvertebrates, Benthic environment, Streams, Wastewater disposal, Stellenbosch, Eerste River.

The Eerste River, situated in southwestern Cape Province, South Africa, has its upper reaches in a stony substratum and can be divided into three physical/biotic zones: the Mountain Stream, Upper River, and Lower River zones. Faunal samples were collected at monthly intervals between March 1975 and April 1976, from eight stations along the river. Abundance and biomass generally increased downstream, but were low below a dam construction site due to blanketing effects of silt on the substratum. Seasonal changes in abundance and biomass of macro-invertebrates differed along the length of the river, because of the presence of dissimilar animal communities. Levels were always low in winter, and peaked in spring. Highest values in both were in the Lower River in summer, reflecting a build-up of organic pollutants there during times of low flow. Species diversity of the Ephemeroptera, which was felt to be representative of the diversity of the total macro-invertebrate fauna, decreased downstream. Major decreases in diversity could be correlated with major changes in the quality of the water: at a town and at a sewage-farm outfall. In the silt-laden waters below a dam construction site, the fleeting occurrence of individuals of several different ephemeropteran species resulted in a high diversity index. Composition of the fauna was typical of local rivers with mountain sources. (Baker-IVI)
W84-03751

MULTIPURPOSE RESERVOIR OPERATION; 1. MONTHLY MODEL FOR A SINGLE RESERVOIR,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and B. Mohammadi.
Journal of Hydrology, Vol. 69, No. 1-4, p 1-14, February, 1984. 4 Fig, 3 Tab, 10 Ref. CSRS project CA-D-LAW-411H, OWRT project A-0880CAL, and WRC project UCAL-WRC-W-617.

Descriptors: *Multipurpose reservoirs, *Model studies, *Reservoir operation, Computers, Linear programming, Systems analysis, Reservoirs.

The monthly operational model of Becker and Yeh (Water Resour. Res., 10:1107-1112, 1974) which maximized energy output of a reservoir system has been extended to allow for maximization of both water and energy from the system. The model is a combination of LP (used for period-by-period) and DP (used for optimization over the entire operation period). At every stage of the DP, a series of LP's are solved. Since the contract levels of water and energy are usually based on conservative estimates of natural inflows, the system is likely to be capable of providing more than these contract levels. The efficiency of the algorithm is improved through the use of parametric LP (reduces computation time) and an iterative solution procedure (which reduces computation time and core-storage requirements). These efficiency measures allow the use of minicomputers, which are more suitable for frequent updating purposes because of their lower cost. The reservoir operation model can easily be adapted for use in multireservoir systems. The iterative solution procedure allows for consideration of more than two primary purposes with relatively low computation time. (Baker-IVI)
W84-03773

MULTIPURPOSE RESERVOIR OPERATION; 2. DAILY OPERATION OF A MULTIPLE RESERVOIR SYSTEM,
California Univ., Davis. Dept. of Land, Air and Water Resources.
B. Mohammadi, and M. A. Marino.
Journal of Hydrology, Vol. 69, No. 1-4, p 15-28, February, 1984. 2 Fig, 4 Tab, 16 Ref. CSRS project CA-D-LAW-4116-H, OWRT project A-088-CAL, WRC project UCAL-WRC-W-617.

Descriptors: *Multipurpose reservoirs, *Reservoir operation, Planning, Management, Computers, Systems analysis, Model studies, Energy, Shasta Reservoir, Folsom Reservoir, California.

Daily operation models often do not consider the multiobjective nature of a reservoir system. The majority of the available models require an initial guess of the operation policy. Although optimality can be reached, the execution time (and therefore the cost of running the model) depends on the initial solution. A daily operation model for maximization of monthly water and energy output from a system of two parallel reservoirs is presented. The model uses optimum monthly water and energy contract levels obtained from the monthly release policy. These contract levels are adjusted to allow for differences between the daily and monthly forecast of inflow. The model is developed using a minicomputer to provide an inexpensive tool for updating the system. The model is applied to the Shasta and Folsom reservoirs of the California Central Valley Project with computation time requirements of less than 2 min. (Baker-IVI)
W84-03774

SUSPENDED MATTER, MAJOR CATIONS AND DISSOLVED SILICON IN THE ESTUARINE WATERS ON THE MAHANADI RIVER, INDIA,

Utkal Univ., Bhubaneswar (India). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W84-03783

RESIDENCE TIME: APPLICATION TO SMALL BOAT BASINS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
For primary bibliographic entry see Field 5B.
W84-03798

ORGANIC AND INORGANIC SULFUR CONSTITUENTS OF THE SEDIMENTS IN THREE NEW YORK LAKES: EFFECT OF SITE, SEDIMENT DEPTH AND SEASON,
State Univ. of New York Coll. of Environmental Science and Forestry. Dept. of Environmental and Forest Biology.
M. J. Mitchell, D. H. Landers, D. F. Brodowski, G. B. Lawrence, and M. B. David.
Water, Air and Soil Pollution, Vol. 21, No. 1-4, p 231-245, January, 1984. 9 Fig, 2 Tab, 45 Ref.

Descriptors: *Organic sulfur, *Inorganic sulfur, *Sediments, *Lakes, Sediment distribution, Sulfur, Oligotrophic lakes, Mesotrophic lakes, Eutrophic lakes, Chemical properties, Deposition, Oneida Lake, South Lake, Deer Lake, New York.

Sulfur, an essential nutrient, is found in both organic and inorganic forms. In oxygenated water, sulfate is the most common form of inorganic S, while anoxic conditions permit formation of reduced inorganic spedies such as sulfides. Water and sediment parameters, with emphasis on S constituents, were compared among lakes (Oneida, South, Deer), seasons, sites and sediment depths. The three lakes differed in size, morphometry, productivity and acid neutralizing capacity and none of the lakes had anoxia in the water column. Redox potentials (Eh) were higher for oligotrophic south and mesotrophic Deer than eutrophic Oneida within the sediment. In the water column, the only S constituent measured was sulfate which was higher in nutrient rich Oneida (110 to 490 micromol/l) than South (30 to 70 micromol/l) or Deer (10 to 60 micromol/l). Total S in sediment was higher from South than for either Deer or Oneida. For Deer and South sediment, total S was greatest in the 5 to 15 cm layer, and this was likely due to historical changes in anthropogenic inputs through atmospheric deposition. The high S concentration in South sediment can be accounted for by particulate deposition of S through the water column. Organic S constituents constituted major forms of S in the sediments of the three lakes. Non-HI reducible S, of which carbon-bonded S was a dominant constituent, comprised a major portion of total S in Oneida, South and Deer. Ester sulfate was higher in Oneida than South or Deer. There was an inverse relationship between sediment Eh and sulfide. Pyritic S was measured on bulk samples and constituted 37, 12, and 6% of total S in Oneida, South and Deer. Both inorganic and organic S forms showed season variation and the transformation and translocation of these forms play an important role in the S dynamics of lakes. (Murphy-IVI)
W84-03834

DISTRIBUTION, ABUNDANCE AND CARBON ISOTOPIC COMPOSITION OF GASEOUS HYDROCARBONS IN BIG SODA LAKE, NEVADA: AN ALKALINE, MEROMICTIC LAKE,
Geological Survey, Menlo Park, CA.
R. S. Oremland, and D. J. Des Marais.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2107-2114, December, 1983. 3 Fig, 3 Tab, 61 Ref.

Descriptors: *Big Soda Lake, *Nevada, *Alkaline water, Carbon, Meromictic lakes, *Hydrocarbons, Anoxic water, Bottom sediments, Gases, Ethylene, Propylene, Ethane, Propane, Isobutane, n-Butane, Methane, Water column, Sedimentology, Carbon radioisotopes, Mixolimnion.

Habitats favorable for the early, depositional stages of oil and gas formation probably include aquatic environments with permanently anoxic bottom waters whose sediments receive large inputs of organic matter from their productive surface waters. Only a few studies have characterized the low molecular weight gaseous hydrocarbons found within possible present-day analogues of such ancient anoxic, hypersaline environments. Distribution and isotopic composition (sigma C-13) of low molecular weight hydrocarbon gases were studied in Big Soda Lake (depth = 64 m), an alkaline, meromictic lake with permanently anoxic bottom waters. Methane increased with depth in the anoxic mixolimnion (depth = 20-35 m), reached uniform concentrations (55 microM/l) in the monimolimnion (35-64 m) and again increased with depth in monimolimnion bottom sediments (> 400 microM/kg below 1 m sub-bottom depth). The sigma C-13(CH4) values in bottom sediment below 1 m sub-bottom depth (< -70 per mil) increased with vertical distance up the core (sigma C-13(CH4) = -55 per mil at sediment surface). Monimolimnion C-13(CH4) values (-55 to -61 per mil) were greater than most sigma C-13(CH4) values found in the anoxic mixolimnion (92% of samples had sigma C-13(CH4) values between -20 and -48 per mil). No significant concentrations of ethylene or propylene were found in the lake. However ethane, propane, isobutane and n-butane concentrations all increased with water column depth, with respective maximum concentrations of 260, 80, 23 and 22 nM/l encountered between 50-60 m depth. Concentrations of ethane, propane and butanes decreased with depth in the bottom sediments. Ratios of CH4/(C2H6 + C3H8) were high (250-620) in the anoxic mixolimnion, decrease to approximately 161 in the monimolimnion and increased with depth in the sediment to values as high as 1736. We concluded that methane has a biogenic origin in both the sediments and the anoxic water column and that C2-C4 alkanes have biogenic origins in the monimolimnion water and shallow sediments. The changes observed in sigma C-13(CH4) and CH4/(C2H6 + C3H8) with depth in the water column and sediments are probably caused by bacterial processes. These might include anaerobic methane oxidation and different rates of methanogenesis and C2 to C4 alkane production by microorganisms. (Murphy-IVI)
W84-03862

NITROGEN BUDGET FOR A SMALL CONIFEROUS FOREST STREAM,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. J. Triska, J. R. Sedell, K. Cromack, Jr., S. V. Gregory, and F. M. McCorison.
Ecological Monographs, Vol 54, No. 1, p 119-140, March, 1984. 3 Fig, 9 Tab, 106 Ref. NSF grants DEB 74-20744A02 and DEB 767-21402.

Descriptors: *Nitrogen budget, *Streams, Nitrogen cycle, Nitrogen, Nitrogen fixation, Allochthonous, Cycling nutrients, Oregon.

Small streams draining heavily forested watersheds depend on organic inputs from the adjacent terrestrial environment (Allochthonous) as a source of fixed carbon and nutrients for in situ biological processes. An annual nitrogen budget is presented for a small stream draining Watershed, 10, H. J. Andrews Experimental Forest, Oregon. The role of allochthonous debris in the input, flux, and export of nitrogen is emphasized in the material balance budget. All material entering the stream channel was presumed to enter the water sometime during the year. Material estimates are based on total channel area. The major annual nitrogen input (1974-1975) was subsurface flow (11.06 g/sq m) as dissolved organic nitrogen (10.56 g/sq m) and nitrate (0.05 g/sq m). Biological inputs of nitrogen amounted to 4.19 g/sq m as direct terrestrial inputs of: litterfall (1.35 g/sq m), laterial movement (1.78 g/sq m), and throughfall (0.30 g/sq m). Nitrogen fixation on fine wood debris contributed an additional 0.76 g/sq m based on rates from a nearby watershed. Total nitrogen input was 15.25 g/sq m. The nitrogen pool was dominated by large amounts of particulate organic matter. Coarse wood constituted 32% of the nitrogen pool (3.80 g/sq m) and fine wood fractions 18% (2.18 g/sq m). The coarse wood fraction greatly influenced stream morphology. Fine organic particulates constituted an additional 40% of the nitrogen pool (4.77 g/sq m). DON (dissolved organic nitrogen) export (8.38 g/sq m) was less than input, presumably due to biological uptake associated with litter mineralization, sorption, and chemical flocculation. Due to effective retention of particulate inputs by debris dams, biological processing in the particulate nitrogen pool, and uptake and sorption of DON, most particulate organic inputs increased in nitrogen concentration prior to export. Particulate organic nitrogen input (3.13 g/sq m) was greater than export (2.53 g/sq m). Total annual nitrogen output was 11.36 g/sq m, resulting in a gain of 3.89 g/sq m/yr to the stream. Thus, the stream was not operating on an annual steady state, but on an input-output regime related to the processing of refractory wood debris and resetting by major storms. Although particulate and dissolved nitrogen loss per hectare was small for the 10-ha watershed, these losses passed through or were accumulated in a pool encompassing < 1% of the watershed area. This concentration of N in the stream allowed establishment of a separate ecosystem whose processing efficiency and capabilities for nutrient cycling were related to the retention capacity of the channel and nutrient quality of inputs within the reach. (Murphy-IVI)
W84-03880

FISH ASSEMBLAGES IN A RIVER WITH UNUSUAL GRADIENT (LUONGO, AFRICA - ZAIRE SYSTEM), REFLECTIONS ON RIVER ZONATION, AND DESCRIPTION OF ANOTHER NEW SPECIES,
Guelph Univ. (Ontario). Dept. of Zoology.
E. K. Balon, and D. J. Stewart.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 225-252, 1983. 14 Fig, 5 Tab, 92 Ref.

Descriptors: *Rivers, *Fish, *Luongo River, Africa, Zaire System, Zones, Species diversity, Topography, Drainage basins, Spatial distribution.

Fish distribution was studied in a river with an unusual gradient within the drainage system of Zaire headwaters. The Luongo River has high gradient upper and lower sections, separated by a long middle section of no gradients, and bordered by rapids and waterfalls. On the basis of Luongo's hydrographic history, topography and fish taxocenes, the river is divided into saltatory zones, each one inhabited by separate homeostatic fish communities. The problem of river natural zonation is argued. Luongo River is also unique for its high richness containing 49 species, its biogeographical correlations, and the number of undescribed species found (14%). One of these previously undescribed species, Chetia mola, is discussed. The probable reasons for the richness and for the discontinuous fish assemblages are discussed. (Baker-IVI)
W84-03894

INFLUENCE OF CERTAIN ENVIRONMENTAL FACTORS ON THE PREDATORY EFFICIENCY OF THE LARVIVOROUS FISH MACROPODUS CUPANUS,
Kerala Univ., Trivandrum (India). Dept. of Aquatic Biology and Fisheries.
S. S. Jacob, N. B. Nair, and N. K. Balasubramanian.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 295-300, 1983. 4 Fig, 4 Tab, 29 Ref.

Descriptors: *Fish behavior, *Predation, Feeding rates, Alternative planning, Mosquitoes, Biocontrol, Fish diets, Fish food organisms.

Investigations of the effect of certain environmental factors on predatory efficiency of the indigenous larvivorous fish Macropodus cupanus indicates the dependence, in a quantifiable way, of predation on the environmental complex surrounding the prey-predator system. Prey consumption is less at low temperatures and increases significantly with rise in temperature. Feeding under conditions of light is significantly higher than in darkness. Salinities of up to 21.83% do not affect predation rate, except that owing to stress conditions, prey intake at 21.83% is lower than at 0.12%. Consider-

ing fish size, in terms of unit body weight, predation declines significantly as size increases. However, when total body weight is considered, predation increases with increase in fish size. Environmental factors do not alter the time course of predation regularly or significantly, perhaps owing to haphazard intake subsequent to satiation and/or a 'learning' factor. The higher predation rate of this fish when compared to the conventional larvivore Gambusia affinis indicates its potential as a biocontrol agent of mosquito larvae. (Author's abstract)
W84-03896

CHARACTERISTICS OF A GENERAL MATHEMATICAL MODEL OF WATER-QUALITY MANAGEMENT IN LARGE RESERVOIRS,
Yu. S. Vasil'ev, G. V. Simakov, and A.I. Al'khimenko.
Hydrotechnical Construction, Vol. 17, No. 8, p 432-434, August, 1983. 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 36-37, August, 1983.

Descriptors: *Water quality, *Reservoirs, *Mathematical models, Stochastic process, Reservoir management, Water quality control, Prediction.

A model is sought which will permit predicting the water quality of a reservoir as a function of the concentration of pollutants in the water body both in space and in time. The synthesis of analytical solutions to the problem with results obtained from both prototype and laboratory experimental investigations is the most promising when constructing a general mathematical model of water quality management. It is expedient to compare the existing particular mathematical models oriented towards third- and fourth-generation computers. The occurrence of wind and its parameters must be considered as random variables. Wave parameters are also random variables. It is natural thus that the distribution of pollutant concentrations should be evaluated on the basis of a stochastic approach. In turn the refined mathematical model will make it possible to establish operating regimes of outlets corresponding to reality and to use more completely the self-purifying capacity of a water body. (Baker-IVI)
W84-03912

NITROGEN LOSS FROM FRESHWATER AND SALINE ESTUARINE SEDIMENTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. J. Smith, and R. D. De Laune.
Journal of Environmental Quality, Vol. 12, No. 4, p 514-518, 1983. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Denitrification, *Estuaries, *Sediments, Nitrification, Nitrogen cycle, Nitrogen balance, Nitrogen compounds, Chemical properties.

The predominant inorganic N species present in estuarine sediments is NH4(+). This ion is stable under anaerobic conditions, but in environments that have both aerobic and anaerobic zones, NH4(+)-N can be lost. The magnitude of ammonium-N (NH4+-N) loss from nitrification-denitrification reactions in bottom sediments collected from saline and freshwater Louisiana Gulf Coast lakes was determined. Studies were collected in the laboratory and field. Maximum gaseous N accumulation, from fresh-water and saline sediment amended with 4.5 microg nitrate-N (NO3(-)N)/g (on dry-wt basis), was 1.6 and 1.4 microg N/g, respectively. The addition of 50 microg NH4(+)-N/g stimulated the evolution of N2O from both sediments, and represents 0.02 and 0.2% of the NH4(+)-N applied to the saline and fresh sediment, respectively. Nitrous oxide (N2O) emissions measured in the field were low. The annual N2O emission was 10 and 34 mg N/sq m from the saline and freshwater lakes. These values agree closely with the N2O emission rates calculated from laboratory data. Denitrification was also estimated from NH4(+)-N amended sediment using the acetylene (C2H2) inhibition technique and N-15 balance. Recovery of N-15 decreased rapidly during the 0- to 8-week period when high denitrification rates were measured. The denitrification rate estimated from N-15 recovery during the 0- to 8-week period was 3.7 mg N/sq m/d for each sediment. Approximately 50% of the added N-15 was lost, an amount equivalent to 1.4 g N/sq m/y. As the added N-15H4(+)-N was incorporated into the organic N pool, little or no further N-15 was lost. (Murphy-IVI)
W84-03929

FATE OF OXYGEN AND REFRACTORY ORGANICS IN MARMOT BASIN STREAMS: SEASONAL VARIATIONS,
Inland Waters Directorate, Ottawa (Ontario).
S. A. Telang, and G. W. Hodgson.
Journal of Environmental Quality, Vol. 12, No. 4, p 575-579, 1983. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Oxygen, *Organic compounds, *Marmot Basin, Total organic carbon, Chemical oxygen demand, Biological oxygen demand, Dissolved oxygen, Fulvic acids, Humic acids, Tannins, Lignins, Stream degradation, Alberta, Canada.

A conceptual process reactor model with input-output functions developed for the mountain streams of the Marmot Basin (Alberta, Canada) showed seasonal trends in the conversion of organic matter. Based on mass balance data, organic compounds (e.g., tannins and lignins), and total organic C showed net gains in the stream waters in winter; in spring, the compounds tend to be depleted in waters; in the fall, humics and tannins and lignins underwent net depletion. The indicated changes of accumulation and depletion ranged from +95 to -42% of incoming mass. The chemical O2 demand showed gains in the stream waters throughout the season. The biological O2 demand showed little change throughout the seasons. Photochemical processes appeared to be important processes in the conversion of organic matter in clear, cold mountain streams of the Marmot Basin. Biological uptake of refractory compounds appeared to be a minor process. (Author's abstract)
W84-03933

ECOLOGICAL SEASONAL CYCLES IN A COLORADO MOUNTAIN POND,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
P. M. Ellsworth.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 225-237, December, 1983. 2 Fig. 46, Ref.

Descriptors: *Zooplankton, *Ponds, *Seasonal variations, Mountains, Population dynamics, Dissolved solids, Alkalinity, Conductivity, Limnology.

A permanent point at 3100 meters elevation was studied for an entire year to monitor zooplankton populations as they changed seasonally and associate those changes with biotic and abiotic factors. Conductivity, alkalinity, and dissolved solids were low during the summer but increased dramatically in the winter due to freezing out. Chlorophyll measurements indicated that phytoplankton reached its population maximum during the winter. The summer zooplankton community was dominated by the cladocerans, Holopedium gibberum and Daphnia rosea; the copepod, Diaptomus leptopus; the rotifers, Keratella cochlearis, Conochilus unicornis, and Polyarthra dolichoptera; and Chaoborus larvae. D. rosea disappeared from the plankton in August, possibly due to a combination of predation and competition. All limnetic Crustacea disappeared during ice cover, leaving rotifers as the most successful winter plankters. The posterior spine of K. cochlearis was long in the summer, and short or absent in the winter. This seasonal change in morphology may be a means of reducing mortality due to predation. (Baker-IVI)
W84-03956

BENTHIC MACROINVERTEBRATES OF SELECTED HABITATS OF THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. C. Beckett, C. R. Bingham, and L. G. Sanders.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 247-261, December, 1983. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Macroinvertebrates, *Mississippi River, *Invertebrates, Benthic environment, Flow, Flow characteristics, Water currents, Velocity, Substrate.

The distribution of benthic macroinvertebrates was studied in four aquatic habitat types in the lower Mississippi River: dike fields, a natural bank, a secondary channel, and an abandoned channel over a high flow, two moderate, and two low flow periods. Only minor changes in composition over the various flow regimes were displayed by the biotas present in the natural bank, the secondary channel, and the abandoned channel. The natural bank was consistently dominated by the burrowing mayflies Tortopus incertus and Pentagenia vittigera and hydropsychid caddisflies; the consistently most common taxa in the secondary channel were the sand-dwelling chironomids Robackia claviger and Chernovskiia orbicus; phantom midges, tubificid oligochaetes, and fingernail clams were always the most abundant macroinvertebrates in the abandoned channel. The dike fields, however, showed large changes in biotic composition over the different flow regimes. These compositional changes correlated with changes in river stage and resultant alterations in current and substrate. The distribution of macroinvertebrates in the lower Mississippi River appears to be a function of the physical characteristics of the system, notably current velocity and substrate composition. (Baker-IVI)
W84-03957

COMPARISON OF MULTIPLATE AND SURBER SAMPLERS IN A COLORADO MOUNTAIN STREAM,
Chadwick and Associates, Littleton, CO.
For primary bibliographic entry see Field 7A.
W84-03958

MEASURED AND PREDICTED FLUXES OF BIOGENIC SILICA IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. L. Schelske, B. J. Eadie, and G. L. Krausse.
Limnology and Oceanography, Vol. 29, No. 1, p 99-110, January, 1984. 4 Fig, 3 Tab, 31 Ref. EPA grants R-806294 and R-804503.

Descriptors: *Lakes, *Silica, *Lake Michigan, Great Lakes, Seasonal variations, Sediments, Chemical analysis, Diatoms, Biogenic silica.

Because of excess phosphorus inputs, epilimnetic diatom production in Lake Michigan is limited by available supplies of silica during summer stratification. Biogenic silica fluxes obtained from sediment trap collections in the offshore waters of Lake Michigan were compared with fluxes predicted from the silica disappearance model. Measured and predicted fluxes were in good agreement for offshore stations, but at stations closer to shore measured fluxes were 2-3 times greater than predicted fluxes. Little of the diatom production was dissolved in the water column as demonstrated by sediment trap and water chemistry data. Greater than predicted fluxes must occur therefore at nearshore locations and these were attributed to new silica supplied from upwellings, tributary inputs, and recycling and resuspension in nearshore sediments. The good agreement between measured and predicted fluxes in offshore waters shows that biogenic silica fluxes may be used to determine the collecting efficiency of sediment traps. (Baker-IVI)
W84-03963

PREDICTION OF INTERNAL PHOSPHORUS LOAD IN LAKES WITH ANOXIC HYPOLIMNIA,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. K. Nurnberg.
Limnology and Oceanograpy, Vol. 29, No. 1, p 111-124, January, 1984. 4 Fig, 7 Tab, 61 Ref.

Descriptors: *Model studies, *Lakes, *Phosphorus load, *Hypolimnion, *Anoxic conditions, Nutrients, Eutrophication, Prediction, Phosphorus retention.

Two models are given to predict internal phosphorus load in lakes with anoxic hypolimnia. The first predicts internal load as the difference between the observed phosphorus retention in anoxic lakes and that predicted by a formula that adequately describes phosphorus retention in anoxic lakes. The second model predicts internal load as the product of an average rate of phosphorus release from anoxic sediments, the surface area of the anoxic sediment, and the period of anoxia. Predictions of the first model compare favorably with 17 observed values of internal load. These models suggest that mean phosphorus concentration in anoxic lakes can be predicted in two ways. One can use whole-lake phosphorus budget models which implicitly incorporate internal phosphorus load, because they include a measurement of phosphorus retention. Alternatively, a term to account for the internal load can be added to current models based on external load and predicted retention. (Baker-IVI)
W84-03964

ORIGIN OF A METALIMNETIC CHRYSOPHYTE PEAK,
Scarborough Coll., Westhill (Ontario).
F. R. Pick, C. Nalewajko, and D. R. S. Lean.
Limnology and Oceanography, Vol. 29, No. 1, p 125-134, January, 1984. 5 Fig, 1 Tab, 34 Ref.

Descriptors: *Lakes, *Chrysophyta, *Chlorophyll, *Jacks Lake, *Ontario, Algal growth, Eutrophication, Metalimnion, Chrysosphaerella, Excystment.

A metalimnetic chlorophyll peak in Jacks Lake, Ontario, was due mainly to a colonial chrysophyte, Chrysosphaerella longispina. The peak did not result from an in situ growth, nor a passive and progressive accumulation of epilimnetic cells. Rather, a sudden bloom of the algae occurred in the epilimnion at the end of June, due to excystment. This bloom then descended rapidly and after no more than 4 days, it was concentrated in a narrow band below the thermocline. No net increase was observed in chlorophyll a or cell biomass with time once the population was established in this region. No dividing cells were observed. After about 2 weeks the chlorophyll a concentration at the peak started to decline and the peak disappeared by the end of August. The measurement of chlorophyll a greatly exaggerated the importance of metalimnetic peaks. (Baker-IVI)
W84-03965

EFFECT OF THE ASIATIC CLAM, CORBICULA FLUMINEA, ON PHYTOPLANKTON OF THE POTOMAC RIVER, MARYLAND,
Geological Survey, Reston, VA.
R. R. H. Cohen, P. V. Dresler, E. J. P. Phillips, and R. L. Cory.
Limnology and Oceanograpy, Vol. 29, No. 1, p 170-180, January, 1984. 9 Fig, 4 Tab, 33 Ref.

Descriptors: *Rivers, *Phytoplankton, Population dynamics, Potomac River, Clams, Tidal rivers.

The freshwater, tidal Potomac River has produced high concentrations of phytoplankton during every July-September low flow period of the 1960's and 1970's, but in the summers of 1980 and 1981 phytoplankton abundance between Rosier Bluff and Hatton Point was 40-60% lower than that upstream and downstream. In 1980 and 1981 the highest biomass of the Asiatic clam, Corbicula fluminea, was in the same reach as the phytoplankton abundance 'sag.' The volume of the sag reach could be pumped through the Corbicula population in 3-4 days as indicated by filtration rates. Corbicula removed 30% of the phytoplankton chlorophyll a from a river water sample in 2 hr. Pheophytin a in surficial sediments correlated well with clam biomass as a consequence of phytoplankton excreted in pseudofeces. The theories that peak discharge, zooplankton, toxic substances, and nutrient limitation induced the sag were not supported. (Baker-IVI)
W84-03966

24-H CHANGES IN CHLOROPHYLL CONTENT OF PHYTOPLANKTON OF LAKE JELONEK, AS COMPARED WITH THE PHYSICAL AND CHEMICAL PROPERTIES OF WATER,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
For primary bibliographic entry see Field 5C.
W84-03988

FULL DIURNAL OBSERVATIONS ON CHANGES IN APHANIZOMENON FLOS-AQUAE (L.) RALFS ON THE BACKGROUND OF PHYSICO-CHEMICAL CONDITIONS IN LAKE SWIETOKRZYSKIE DURING THE 1980 SUMMER PERIOD,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrology.
L. Burchardt, and J. Panczakowa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 229-246, 1983. 11 Fig, Tab, 28 Ref.

Descriptors: *Lakes, *Algae, *Chlorophyll, *Aphanizomenon, *Lake Swietokrzyskie, *Poland, *Diurnal variation, Seasonal variations, Nitrogen, Phosphorus, Nutrients, Eutrophication, Acidity, Dissolved oxygen, Biochemical oxygen demand.

Full diurnal algaelogic and physicochemical investigations carried out in July and August 1980 at various stages of Aphanizomenon flos-aquae blooming showed maximum numbers of Aphanizomenon flos-aquae individuals occurred in July at 21 hours and in September at 18 hours. Maximal chlorophyll c content, pH, dissolved oxygen, BOD5, and oxygen consumption occurred at the same hours. Wind direction and its force were the factors deciding the density of Aphanizomenon flos-aquae individuals in the surface water layer of Lake Swietokrzyskie (Poland). The high level of biogens in the water body resulted from the fact that no distinct differences in the value of these compounds was observed over a 124 hr period notwithstanding considerable fluctuations in the numbers of Aphanizomenon flos-aquae trichomes. Larger amounts of chlorophyll a were noted during the afternoon hours in the cells of Aphanizomenon flos-aquae from samples taken at a depth of 5.0 to 5.5 m than from the surface. It appears that for proper distinction of the processes taking place between microorganisms and the water environment full diurnal investigations will be needed at periods most critical to the water body. Maximal values for numbers of algae individuals, dissolved oxygen, BOD5, oxygen consumption and pH occurring in July and August at 21.00 and 18.00 hours indicate that these hours are the most suitable for studies aimed at evaluating the intensiveness of changes taking place in a water body during a day. (Baker-IVI)
W84-03989

SOURCES AND MOLECULAR WEIGHT OF 'DISSOLVED' ORGANIC CARBON IN AN OLIGOTROPHIC LAKE,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
J. J. Cole, W. H. McDowell, and G. E. Likens.
OIKOS, Vol. 42, No. 1, p 1-9, January, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Oligotrophic lakes, *Mirror Lake, *New Hampshire, Molecular weight, Water pollution sources, Ultrafiltration, Precipitation, Soil solution, Algal growth, Decomposition, Residence time.

Ultrafiltration was used to try to determine the origin of dissolved organic carbon (DOC) in Mirror Lake, New Hampshire. The distribution of molecular weights of DOC was relatively constant with depth and season, with a predominance of high-molecular weight (>100,000 daltons; 31%) and moderate-molecular weight compounds (1,000 to 10,000 daltons; 36%). The distribution of molecular weights of DOC in the lake was distinctly different from that of the DOC which entered the lake in stream water, soil solution, or precipitation. Lake water is relatively enriched in DOC above 100,000 daltons; this high-molecular weight DOC is apparently produced within the lake. One autochthonous source of DOC above 100,000 daltons is that produced during algal growth and decomposition. An input/output budget of the DOC for each molecular weight class suggested that most of the DOC in the lake resides in the lake for several years. (Author's abstract)
W84-04053

RIVER EPILITHON: TOWARD A STRUCTURAL-FUNCTIONAL MODEL,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
M. A. Lock, R. R. Wallace, J. W. Costerton, R. M. Ventullo, and S. E. Charlton.
OIKOS, Vol. 42, No. 1, p 10-22, January, 1984. 5 Fig, 3 Tab, 68 Ref.

Descriptors: *Rivers, *Epilithon, *Microorganisms, Diatoms, Blue-green algae, Invertebrates, Algae, Bacteria, Glycocalyx, Photosynthesis, Running waters.

Granite and epoxy resin substrates anchored in the Muskeg and Steepbank rivers (Alberta) were used to sample the epilithon. A vigorous epilithon develops both on the upper and lower surfaces of the rock and plastic substrates in these boreal rivers. The epilithic community is usually much more extensive on the upper surface; however, the epilithon on the lower surface is sometimes equally well developed and often contains large numbers of chlorophyll-containing microorganisms (both blue-green algae and diatoms). Morphological evidence suggests grazing of the epilithon by invertebrates, and clearly shows that the cellular components of this sessile community grow in distinct microcolonies within a continuous fibrous anionic matrix composed of bacterial and algal glycocalyces. The theoretical ramifications of this demonstration of a complex epilithon, in the context of bacterial digestive processes, nitrogen cycling, metal sorption, and the flux of organic matter in the stream ecosystem analyzed in terms of a structural-functional hypothetical model of the epilithon. Although algae and their associated photosynthetic capacity may at times apparently dominate the epilithon, there may be equally inportant system roles associated with the substantial heterotrophic community. Also the epilithon is a major element in running water light and organic energy transactions because of its optimum position for photosynthetic processes in many rivers and its optimum position for capturing organic energy from the overlying water. (Moore-IVI)
W84-04054

LEAF PROCESSING CAPABILITIES OF AQUATIC HYPHOMYCETES: INTERSPECIFIC DIFFERENCES AND INFLUENCE ON SHREDDER FEEDING PREFERENCES,
New Mexico State Univ., Las Cruces. Dept. of Biology.
T. L. Arsuffi, and K. Suberkropp.
OIKOS, Vol. 42, No. 2, p 144-154, January, 1984. 7 Fig, 5 Tab, 27 Ref. NSF grant DEB 7922997.

Descriptors: *Detritus, *Hyphomycetes, *Leaves, *Feeding, *Caddisflies, Decomposition, Streams, Aquatic life.

Litter inputs from the surrounding terrestrial vegetation comprise a potentially important nutrient and energy base in streams. Macroinvertebrate detritivores rely on this material as an important component of their diets, but in its original form, leaf detritus is an unsuitable food source. Leaf litter is converted by microbial activity into a more palatable and nutritional food source. Degradative abilities of aquatic hyphomycetes and the relationship between fungal-mediated conditioning of aspen leaves and feeding responses of caddisfly (Trichoptera) detritivores were examined. Interactive effects of conditioning time and fungal species were determined by conducting preference experiments in separate enclosures with all treatments (conditioning times and fungal species) or each conditioning time with all fungi. Preferences were established by comparison of leaf consumption among various treatments. Interspecific differencs among fungi in their physical-chemical modifica-

tion of aspen leaves were primarily rate-related. For three fungi, preferences exhibited by larvae were not accounted for by either the fungal species or conditioning time alone, but rather, their interaction. The most palatable leaves were those colonized with these fungi at times subsequent to the appearance of detectable pectin lyase activity. At these times, leaves were initially softened, exhibited substantial weight loss and almost doubled their nitrogen content in comparison to uninoculated leaves. Leaves colonized by one fungal species were unpalatable regardless of the degree of conditioning. (Moore-IVI)
W84-04055

GROWTH LIMITING FACTORS FOR OSCILLATORIA AGARDHII AND DIATOMS IN EUTROPHIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
O. Lovstad.
OIKOS, Vol. 42, No. 1, p 185-192, January, 1984. 6 Fig, 1 Tab, 38 Ref.

Descriptors: *Oscillatoria, *Diatoms, *Eutrophic lakes, *Growth, Phosphorus, Silica, Limiting nutrients, Trace metals, Chelators.

Laboratory batch experiments were carried out to determine growth limiting nutrients and the degree of growth limitation for some diatoms and red and green forms of Oscillatoria agardhii Gom. Water samples from three lakes with average limnetic total phosphorus concentrations from 15 to 200 microg P/l were analysed. With the exception of Stephanodiscus hantzschii Grun all the diatoms investigated became growth limited at very low SRP or phosphate concentrations. Asterionella formosa Hass, probably grows more efficiently at low concentrations of phosphate than Synedra cf. acus Kutz. and Fragilaria crotonensis Kitt., but was competitively displaced at high pH levels (> 9). Stephanodiscus competitively displaced the other diatoms at low molar Si:P ratios, i.e. less than 10. Oscillatoria grew better at very high pH levels (> 10) than the diatoms. Addition of phosphate and chelated iron (FeEDTA) singly or in combination was, however, often necessary to increase the growth rate of Oscillatoria under nutrient limiting conditions. This indicates that both external concentrations of phosphate or some trace metals or chelators have to increase to above some threshold level at least during parts of the year, if Oscillatoria shall become dominant. Results of the experiment indicate that SRP and SRSi concentrations measured chemically may be similar to the available concentrations of phosphate and silicate respectively. (Author's abstract)
W84-04056

DECOMPOSITION OF PLANKTONIC ALGAE IN AN OLIGOTROPHIC LAKE,
02750e Biological Lab., Woods Hole, MA.
J. J. Cole, G. E. Likens, and J. E. Hobbie.
OIKOS, Vol. 42, No. 3, p 257-266, March, 1984. 7 Fig, 1 Tab, 36 Ref.

Descriptors: *Oligotrophic lakes, *Decomposition, *Algae, *Plankton, *Mirror Lake, *New Hampshire, Incubation, Particulates, Carbon dioxide, Metabolism, Bacteria.

A new procedure (dip incubation) was used to measure both the dissolution and mineralization (to CO2) of killed C-14 labelled phytoplankton in an oligotrophic lake. This procedure, based on a series of 24-h incubations in bottles, avoids the problem of extremely long incubations and can be used to measure, independently, the dissolution and mineralization rates of algal detritus of any recent age. In Mirror Lake, New Hampshire, the conversion of particulate carbon to CO2 occurred only in the presence of living microorganisms and was strongly influenced by the age of the algal detritus and the water temperature. There was a pronounced annual cycle of the conversion of particulates to CO2 with highest rates (average rate for 6 d of 6%/d) during summer and lowest rates (average rate for 6 d of 0.5%/d) in winter. In comparison to these average rates, the initial rates of both dissolution and mineralization were higher and much less dependent upon temperature. These initial rates, taken alone, would give an erroneously high estimate of the rate of decomposition and underestimate the importance of temperature as a factor controlling decomposition. We used an annual cycle of these measurements in conjunction with models of the age structure of particulate detritus to estimate the metabolism of algal C by planktonic microbes. Our estimate (3.6 to 4.3 micro g C/l/d) is comparable to previous measurements of total microbial respiration (of all C-sources) in both amount (3.1 micro g C/l/d) and annual pattern. This comparison suggests that algal carbon is a major C-source for planktonic bacteria in the epilimnion of Mirror Lake. (Author's abstract)
W84-04057

VARIATIONS IN THE LEVEL OF LAKE MALAWI,
University Coll., Cardiff (Wales). Dept. of Civil and Structural Engineering.
R. S. Drayton.
Hydrological Sciences Journal, Vol. 29, No. 1, p 1-12, 1984. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Water level, *Lake Malawi, Africa, Precipitation, Rainfall, Runoff, Outflow, Water balance.

Lake Malawi is the third largest lake in Africa, with an area of 28,750 sq km. Throughout this century, the water level of Lake Malawi has varied widely. During the period 1976-1980, this level rose dramatically. The causes of these changes were investigated using Monte Carlo techniques and equations based on the water balance of the lake. The model study showed that as increase in average rainfall equal to that recorded between 1915 and 1937, and between 1940 and 1979, is sufficient to have caused to recorded rise in average lake level over those periods. Changing the runoff rates in the model showed that small increases in the rate of runoff would make a significant contribution to rising lake levels. The exceptional rises of level in recent years can be attributed to the very much increased amount of freewater available to the system. This excess of freewater resulted from the very high rainfall over the lake itself, and to a lesser degree from high inflow. The high inflow resulted from above-average rainfall over the land. Man-made changes in runoff and outflow have been relatively unimportant. (Baker-IVI)
W84-04066

TECHNIQUES FOR DETECTING TRENDS IN LAKE WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. H. Montgomery, and K. H. Reckhow.
Water Resources Bulletin, Vol. 20, No. 1, p 43-52, February, 1984. 1 Fig, 3 Tab, 49 Ref. NOAA grant 03-78-B01-109.

Descriptors: *Lakes, *Water quality, *Trends, Statistical methods, Autocorrelation, Data analysis.

Information on changes in water quality over time is important for water quality management. The use of statistical techniques to detect trends in water quality parameters has the potential to provide the quantitative information needed for water resources management and planning decisions. A trend detection method is presented that provides: hypothesis formulation, the statement of the problem to be tested; data preparation, the selection of water quality variable and data; data analysis, the exploratory data analysis techniques; and statistical test, the tests for detecting trends. The starting point for the use of trend detection techniques is the determination of water quality characteristics upon which proper management and planning decisons are to be based. These characteristics determine the variables and data chosen, and the formulation of the null and alternative hypotheses. The frequent presence of autocorrelation in lake data prohibits straightforward use of most statistical techniques, including regression, based on the violation of the independence assumption. The statistical tests for dependent data are suggested for use, almost exclusively, when dealing with lake systems. The method is utilized in a stepwise fashion and is presented in a nonstatistical manner to allow use by those not well versed in statistical theory. (Moore-IVI)
W84-04103

CHEMICAL COMPOSITION OF SOFTWATER FLORIDA LAKES AND THEIR SENSITIVITY TO ACID PRECIPITATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
C. D. Hendry, and P. L. Brezonik.
Water Resources Bulletin, Vol. 20, No. 1, p 75-86, February, 1984. 8 Fig, 5 Tab, 48 Ref. EPA grant 805560.

Descriptors: *Florida, *Softwater lakes, *Acid rain, Aluminum, Nutrients, Chlorophyll a, Hydrogen ion concentration, Alkalinity, Sulfates, Acidification, Lakes.

Based on alkalinity data for 596 lakes, 31% of Florida's 7300 lakes have < 100 micro eq/L alkalinity and are sensitive to acid deposition. More than two-thirds of the lakes in 12 northern Florida counties fit this criterion. Increasing aluminum and decreasing nutrient and chlorophyll a concentrations were observed with decreasing pH in a survey of 20 softwater lakes. Maximum measured aluminum values (100-500 micro g/L) are below levels associated with fish toxicity. Factor analysis showed that lake chemistry was related to three principal factors, representing three major processes: watershed weathering, acidification, and nutrient inputs. An acidification index defined as the difference between excess SO4(2-) and excess (Ca(2+) + Mg(2+)) accounted for 74% of the variance in lake pH. Comparison of historical (late 1950s) and present data for pH, alkalinity, and excess SO4(2-) indicated loss of alkalinity (> 25 micro eq/L) and increases in excess SO4(2-) (16-34 micro eq/L) in several softwater lakes. (Author's abstract)
W84-04107

DYNAMICS OF ADDED NITRATE AND PHOSPHATE COMPARED IN A NORTHERN CALIFORNIA WOODLAND STREAM,
William Paterson Coll. of New Jersey, Wayne. Dept. of Biology.
M. J. Sebetich, V. C. Kennedy, S. M. Zand, R. J. Avanzino, and G. W. Zellweger.
Water Resources Bulletin, Vol. 20, No. 1, p 93-101, February, 1984. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Nitrates, *Phosphates, *Little Lost Man Creek, *California, Cycling nutrients, Dispersion, Streams, Biota, Sediments.

Injections of NO3 and PO4 were made during September 1975 into Little Lost Man Creek, a small pristine stream in Redwood National Park, California. Chloride, a conservative constituent, was added in a known ratio to the nutrients. Nutrient loss at a downstream point was calculated using concentration of added Cl as a reference. Nitrate nitrogen (NO3-N), added for 4 h, reached 920 micro g/l (above 5 micro g/l background) just below the injection point, but increased only to 405 micro g/l at 310 m downstream. The concentration decrease was attributed to dispersion and to uptake by stream biota. Percent of NO3-N lost decreased with increasing concentration of NO3-N. Phosphate phosphorus (PO4-P) was added a week after the NO3-N for 3 h, causing a concentration increase of 296 micro g/l (above 13 micro g/l background) just below the injection point, of 161 micro g/l at 90 m downstream, and of 98 micro g/l at 310 m. Percent loss of PO4-P at downstream sites increased with increasing PO4-P concentration and also for a short period after peak concentration occurred, but then decreased as PO4-P concentration continued decreasing. Differences in stream response to added NO3-N and PO4-P are attributed to differing rates of reaction with biota and differing degrees of interaction with abiotic stream solids. (Author's abstract)
W84-04109

WATERBORNE NUTRIENT BUDGETS FOR THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Georgia Univ., Athens. Inst. of Ecology.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.
Agriculture, Ecosystems and Environment, Vol. 10, No. 4, p 371-384, December, 1983. 4 Fig, 4 Tab, 26 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Forests, *Agricultural watersheds, *Nutrients, *Riparian vegetation, Nitrogen, Phosphorus, Calcium, Magnesium, Land management, Groundwater, Precipitation, Land use, Cropland.

Agroecosystems in the southeastern United States Coastal Plain typically have uplands in agriculture with mixed hardwood forests along the stream channels. This study determined the inputs and outputs of waterborne nutrients for the riparian forest ecosystem of an agricultural watershed. Quantities of phreatic groundwater and precipitation nutrient inputs and phreatic and surface nutrient outputs were determined during 1979. Based on input/output budgets, these streamside forests were shown to be effective in retaining N, P, Ca, and Mg. Partial conversion of the riparian forest to cropland was projected to increase NO3-N and NH4-N loads by up to 800%. Total replacement of riparian forest with crops would increase loads of all nutrients studied except organic N, DMRP, and total P. Land managers can maintain the nutrient filtering capacity of the streamside forest by selective harvesting of hardwoods and by maintaining the present hydrologic regime. (Author's abstract)
W84-04114

STRUCTURE AND ANNUAL BIOMASS PRODUCTION OF NYMPHOIDES PELTATA (GMEL.) O. KUNTZE (MENYANTHACEAE),
Katholieke Univ., Nijmegen (Netherlands). Lab. of Aquatic Ecology.
Th. C. M. Brock, G. H. P. Arts, I. L. M. Goossen, and A. H. M. Rutenfrans.
Aquatic Botany, Vol. 17, No. 3/4, p 167-188, December, 1983. 4 Fig, 6 Tab, 39 Ref.

Descriptors: *Nymphoides, *Biomass, *Aquatic plants, *Bemmelse Strang, *Netherlands, Cycling nutrients, Oxbow lakes, Seasonal variation, Submerged plants.

In shallow backwater of the river Waal (Netherlands), the floating leaved macrophyte Nymphoides peltata is common and often represents the dominant vegetation. In 1980 and 1981, the structure and aspects of production, consumption, decomposition, and nutrient cycling of N. peltata were studied quantitatively the the Bemmelse Strang, an oxbow lake of the river Waal. The seasonal changes in the vertical stratification of the biomass were studied in concrete tanks. These seasonal changes were studied with the harvest method, while the estimation of the net primary production was based upon biomass data and turnover rates of various plant parts. The morphological differentiation of N. peltata into roots, short shoots, long shoots, petioles, leaf blades and flowering structures offers a variety of habitats for the accompanying organisms. An important function of N. peltata is the supply of substrates for periphytic organisms. The data are compared with those of other water plants, especially other floating-leaved macrophytes. The maximum submerged surface area supplied by N. peltata in the Bemmelse Strang is intermediate between those reported for emergent and submerged macrophytes. In 1980, N. peltata reached its peak biomass in August being 372 g AFDW/sq m (ash-free dry weight). The annual net productivity of Nymphoides was estimated to be 1036 g AFDW/sq m. The leaf blades and their petioles contributed most to the production. (Moore-IVI)
W84-04115

FACTORS AFFECTING NITROGENASE ACTIVITY ASSOCIATED WITH MARSH GRASSES AND THEIR SOILS FROM EUTROPHIC LAKES,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
M. T. Ogan.
Aquatic Botany, Vol. 17, No. 3/4, p 215-230, December, 1983. 6 Fig, 3 Tab, 28 Ref.

Descriptors: *Grasses, *Nitrogenase, *Soil water, *Eutrophic lakes, Nitrogen, Phosphorus, Phalaris, Phragmites, Temperature, Sunlight, Marshes, Diurnal variation.

The acetylene reduction activity (ARA) of soil-plant cores and intact, soil-free plant-root systems was used to study the influence of soil moisture content, diurnal cycles of temperature and light, and inorganic N and P on the nitrogenase activity (AR) associated with Phalaris arundinacea L. and Phragmites australis (Cav.) Trin. from two eutrophic lakes (lochs), Balgavies and Forfar. A positive correlation ($r = 0.81$, $n = 26$) was established between AR and soil moisture content in individual soil-plant cores of Phalaris from Forfar Loch. Nitrogenase activity, soil moisture and NO2(-)-N increased with decreasing distance from lake water in Balgavies Loch. Diurnal fluctuations in AR, probably attributable to a combined effect of soil temperature and illumination changes, were observed under field conditions for Phalaris and Phragmites. Under laboratory conditions, the shading and cutting of Phalaris shoots did not inhibit ARA, which suggested that new photosynthates did not necessarily supply substrate for activity in the short term. Partial and temporary inhibition of ARA was obtained in dissected soil-plant cores after a single application of NH4(+)-N and NO3(-)-N (350 micro g N/g fresh weight). At concentrations equivalent to 300 micro g P/g fresh weight of Phalaris cores, PO4(3-)-P also caused partial and temporary inhibition of ARA of soil-free plant-root systems, but stimulated activity in intact simulated in situ systems. (Author's abstract)
W84-04116

PHYTOSOCIOLOGICAL STUDY OF THE MACROPHYTIC VEGETATION OF RUNNING WATERS IN WESTERN LOWER SAXONY (FEDERAL REPUBLIC OF GERMANY),
Oldenburg Univ. (Germany, F.R.). Dept. of Biology.
G. Wiegleb.
Aquatic Botany, Vol. 17, No. 3/4, p 251-274, December, 1983. 2 Fig, 3 Tab, 77 Ref.

Descriptors: *Macrophytes, *Rivers, *Western Lower Saxony, *West Germany, Vegetation, Aquatic plants, Plant communities.

A survey was carried out of the macrophytic vegetation in running waters of Western Lower Saxony. Three hundred and eighty-two phytosociological relevees were classified by common table work to 30 vegetation types of different phytosociological validity. The vegetation types are described and floristically characterized. Most of them belong to the complex Sparganium emersum community, which is characterized by the dominant occurrence of the nymphaeid species Sparganium emersum Rehm., Nuphar lutea (L.) Sm., Sagittaria sagittifolia L. and Potamogeton natans L., but magnopotamid-, parvo-potamid-, batrachiid- and pleustophyte-dominated communities also occur. Similarity between the different vegetation types was checked by multivariate techniques, one classification technique (minimum variance clustering) and one ordination techniques (principal components analysis). Additionally, syndynamical relations between the types were studied by observing the vegetation changes of 46 sample points within 2 years. The relations between different vegetation types are shown by combination of the different approaches. Finally, some more general statements are made regarding the handling of such data sets, as well as the consequences of the results for the classification of macrophytic vegetation in Central European rivers. (Author's abstract)
W84-04117

TESTS FOR EVALUATING THE STATUS OF ECOSYSTEMS OF FRESH WATER LAKES WITH MULTIPLE USE,
Moscow State Univ. (USSR).
A. S. Konstantinov.
Hydrobiological Journal, Vol. 19, No. 1, p 1-10, 1983. 2 Fig, 31 Ref.

Descriptors: *Ecosystems, *Lakes, Energy, Reviews, Aquatic life, Hydrobiology.

Tests for evaluating aquatic ecosystems as elements of the biosphere are discussed. The tests are based on the concept of evolution of the biosphere as a system subordinated to the cosmos. The ecosystem energy characteristics, which are of great criterial significance, presently are extremely unsatisfactorily determined due to procedural errors in the hydrobiological determination of production and decomposition. The view of the biosphere as a subsystem of the cosmos allows forecasting the possible consequences of changes in water ecosystems to be made more accurately and supports human efforts to protect the environment. (Baker-IVI)
W84-04130

PHYTOPLANKTON OF THE KURTLINSKOYE RESERVOIR,
Akademiya Nauk Turkmenskoi SSR, Ashkhabad. Inst. Botaniki.
Sh. I. Kogan, and Yu. Ue. Lyubeznov.
Hydrobiological Journal, Vol. 19, No. 1, p 11-17, 1983. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Phytoplankton, *Reservoirs, Kurtlinskoye Reservoir, Eutrophication, Nutrients, Runoff, Agricultural runoff, Water quality.

Long-term studies in the Kurtlinskoye (Turkmenia) reservoir showed that the structure and quantitative development of the phytoplankton there underwent significant changes due to extermination of vascular aquatic plants by the grass carp, and increased pollution. A sharp increase in phytoplankton biomass, oxygen deficit, content of nutrients, oxidizability, and biological oxygen demand suggests that the reservoir is becoming eutrophic. The major cause of pollution in this region is due to increased nutrients entering the water as a result of agricultural runoff. In recent years the fraction of beta-mesosaprobes has increased and that of the oligosaprobes has decreased somewhat. Three periods of development have been isolated from intensive study concerning the phytoplankton in the reservoir. The first period (1966-1970) involved weak quantitative development of the phytoplankton, with maximum taxonomic diversity. The second period (1970-1975) involved a major restructuring of the biocoenosis as a result of the destruction of the vascular plants, and development of the phytoplankton to initial bloom stage. The dominant complex was unstable, and the saprobicity increased. The third period (1975-1978) involved a further increase in the plankton biomass. The plankton community showed only slight yearly changes in composition and productivity. Proper management of the Kurtlinskoye Reservoir is needed if further deterioration of water quality is to be avoided. (Baker-IVI)
W84-04131

MACROBENTHOS COMMUNITIES OF THE NORTH CRIMEAN CANAL,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. A. Kharchenko.
Hydrobiological Journal, Vol. 19, No. 1, p 37-44, 1983. 7 Fig, 1 Tab, 15 Ref.

Descriptors: *Canals, *Macrobenthos, Macrozoobenthos, North Crimean Canal, Invertebrates, Decomposition, Organic matter.

The main coenoses of macrozoobenthos in the North-Crimean Canal (NCC) were identified. The energy flow through these coenoses was calculated. A more productive coenosis exists in the end zone of the canal. Two macrobenthos invertebrate communities were identified in the NCC. Based on an analysis of the species makeup, numbers, biomass, species frequency and metabolic processes of the individual groups of hydrobionts, with allowance for environmental factors, the first bottom coenosis identified in the canal has been named L. hoffmeisteri + P. breviantennatum community of sand clay bottom soils, and the second has been named the Dreissena + p. ferrugineus + D. hae-

mobaphes community of silted clay bottom soils. Decomposition of organic matter is proceeding actively in the canal, prompted to a certain extent by the functioning of the Dreissena consortium. Discovering the mechanism of this effect is a task for future study. (Baker-IVI)
W84-04132

ECOLOGIC PHYSIOLOGY AND BIOCHEMISTRY OF AQUATIC PLANTS AND MICROORGANISMS: CONTRIBUTION TO THE BIOLOGY AND COENOLOGY OF POTAMOGETON PERFOLIATUS L.,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Sh. Gusak, A. I. Merezhko, and V.P. Gorbik.
Hydrobiological Journal, Vol. 19, No. 1, p 54-58, 1983. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Reservoirs, *Aquatic plants, Microorganisms, Kiev Reserovir, Plant growth, Seasonal variation, Distribution.

The structure and biomass of Potamogeton perfoliatus thickets, as well as biometric data on this species were considered in the Strakholesiye shallows of the Kiev Reservoir. Plant biomass was sampled over an area of 100 sq m at a depth of 1.6 m. The Howard-Williams and Longman sampler made it possible to collect samples of plants not only from the surface, but also from the depths. Lateral distribution in the thickets is heterogeneous both in the number of sprouts and biomass. Average biomass was 258 g of bone dry matter, per sq m, most of it concentrated below the first 1.8 m of the plant height. Mean leaf area per sq m of the thickets was 1.72 sq m. In studying the structure of beds of P. perfoliatus, account must be taken not only of the size of the patches, but also of the distribution (density) of plants in them, bearing in mind the nature of the biotope. (Baker-IVI)
W84-04135

ECOLOGICAL CHARACTERISTICS OF PHOTOSYNTHESIS OF PHYTOPLANKTON AND ITS ROLE IN THE ECOSYSTEM OF THE DNIEPER RESERVOIRS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. D. Priymachenko.
Hydrobiological Journal, Vol. 19, No. 1, p 59-67, 1983. 6 Fig, 3 Tab, 10 Ref.

Descriptors: *Reservoirs, *Phytoplankton, Photosynthesis, Dnieper Reservoir, Eutrophication, Primary productivity.

The vertical distribution of the photosynthetic production and of the biomass of the phytoplankton in the Dnieper Reservoirs is expressed by curves of different kinds that do not correlate with one another. Most of the water columns of the Dnieper Reservoirs are fairly well saturated with phytoplankton. Photosynthesis occurs only in the surface layer, depending on insolation. When the density of algae is higher than 40 g/cubic m, photosynthesis rates decrease due to self-shading and reduction in the specific area per unit biomass. The role of phytoplankton in formation of organic matter, its decomposition and as a source of energy resources increases with trophicity of the water. (Baker-IVI)
W84-04136

WATER HUMUS IN LAKES LADOGA AND BAIKAL,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
B. A. Skopintsev.
Hydrobiological Journal, Vol. 19, No. 1, p 88-93, 1983. 2 Tab, 19 Ref.

Descriptors: *Plankton, *Lakes, Lake Ladoga, Lake Baikal, Oligotrophic lakes, Decomposing organic matter.

The nature of the water humus in the oligotrophic Lakes Ladoga and Baikal is considered. Allochthonous, terrigenic humus of soil and bog origin dominates in Lake Ladoga; autochthronous, planktonogenic humus in Lake Baikal. The analytical criteria were water color, rate of phytoplankton production, ratios between permanganate oxidizability and bichromate oxidizability and organic carbon. Validity of such an approach is confirmed by results of studies of different researchers on the nature of soil humus, sapropel, plankton and planktonogenic humus of waters and benthic deposits of the ocean and certain seas. Aromatic (cyclic) compounds are proved to dominate in terrigenic humus and aliphatic (acyclic) ones in the planktonogenic humus. (Baker-IVI)
W84-04137

WATER BALANCE OF A SMALL LAKE USING STABLE ISOTOPES AND TRITIUM,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
J. V. Turner, G. B. Allison, and J. W. Holmes.
Journal of Hydrology, Vol. 70, No. 1-4, p 199-220, 1984. 14 Fig, 7 Tab, 21 Ref.

Descriptors: *Lakes, *Hydrologic budget, *Blue lake, *Australia, *Isotopic tracers, *Tritium, Recharge, Groundwater, Residence time, Carbon radioisotopes, Oxygen radioisotopes, Deuterium.

A small maar lake, known as the Blue Lake, set in a karstic region of southeastern Australia, provides the municipal water supply for a population of approximately 20,000. The lake has a volume of 36,000,000 cu m, of which 10-15% is pumped from it each year. The lake is recharged almost entirely from groundwater and the main objective of this study was to estimate the total groundwater inflow and outflow rates. Estimation of groundwater throughflow in a lake is different to assess using classical hydrological techniques and an alternative method involving measurement of the concentrations of the environmental isotopes H-3, O-18, H-2 and C-14 in the lake water and in the recharging groundwater was used to establish the lake-water balance. The water-balance calculations indicated a total groundwater inflow to Blue Lake of between 5,000,000 and 6,500,000 cu m/yr, corresponding to a residence time of water in the lake of approximately 6 yr. It was not possible to derive the relative proportions of inflow to the lake from the two possible source aquifers, using these isotopes, because their concentrations did not show a sufficiently large contrast to distinguish the two water sources. (Author's abstract)
W84-04151

HOLOCENE DEPLETION AND ACTIVE RECHARGE OF THE KALAHARI GROUNDWATERS - A REVIEW AND AN INDICATIVE MODEL,
Botswana Univ., Gaborone. Dept. of Geology.
J. J. De Vries.
Journal of Hydrology, Vol. 70, No. 1-4, p 221-232, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Kalahari desert, *Groundwater recharge, *Holocene, *Groundwater depletion, Topography, Infiltration, Aquifers, Hydraulic gradient.

Groundwater has been encountered in a large number of successful drillings in the Kalahari desert in different areas and formations. Locations of wells and boreholes are unevenly distributed and mostly related to topographic sites where groundwater can be found at shallow depth. A question in the evaluation of groundwater resources in the Kalahari is whether there is any active infiltration of present-day rainfall to the deep aquifers. The present study investigates whether the regional hydraulic gradient means a modern replenishment, or whether the slope of the piezometric surface should be explained as a residual feature resulting from head decay since the last pluvial period. The hydraulic gradient is most probably of a residual nature, and the replenishment has been less than 0.5 mm/yr during at least the last 4000 yr. The present groundwater depth and hydraulic gradient can be explained as a residual head caused by groundwater depletion due to an exceedance of discharge over recharge. The present-day discharge is most probably less than 0.5 mm/yr, and is either in dynamic equilibrium with current recharge, or still exceeds recharge, so that groundwater depletion will continue. Isotope studies gave evidence of local recharge to the Kalahari beds in areas favored by a combination of concentrated surface water and high permeability, creating local aquifers. (Moore-IVI)
W84-04152

SEASONAL CHANGE OF CHLOROPHYLL-A WITH BACTERIOCHLOROPHYLL IN LAKE FUKAMI-IKE,
Nagoya Women's Univ. (Japan). Faculty of Home Economics.
A. Yagi, I. Shimodaira, H. Terai, and Y. Saijo.
Japanese Journal of Limnology, Vol. 44, No. 4, p 283-292, October, 1983. 9 Fig, 13 Ref.

Descriptors: *Bacteria, *Phytoplankton, *Seasonal variation, *Chlorophyll, *Lake Fukami-ike, *Japan, Chlorophyll a, Chlorophyll c, Stratification.

Lake Fukami-ike is a small lake in central Japan having a maximum depth of 8.5 m, and is well protected from the wind. The lake has no inflowing streams, but it receives the runoff water from paddy fields, orchards and a certain amount of domestic sewage. The lake was stratified from March to October and circulated from November to March. Anoxic condition prevailed below 4-5 m depth from April to October. The amount of chlorophyll-a in the euphotic layer was low during the stagnation period, and high during the circulation period. Such a seasonal change in chlorophyll-a amount might be caused by: the interruption of upwards nutrient transportation form the tropholytic layer due to a distinct stagnation of water and the consumption of nutrients by photosynthetic sulfur bacteria growing near the top of anoxic layer in summer; and the sequential change of circulation and stagnation of water, producing favorable conditions for phytoplankton growth in winter. The highest values for bacteriochlorophyll c, about 140 to 120 micro g/l, were found near the top of the anoxic layer in the summer. (Moore-IVI)
W84-04165

DAILY OXYGEN BUDGETS IN A SUBMERGED PLANT STAND IN BROA RESERVOIR, SOUTHERN BRAZIL,
Chiba Univ. (Japan). Inst. of Marine Ecosystem.
I. Ikusima, K. Hino, and J. G. Tundisi.
Japanese Journal of Limnology, Vol. 44, No. 4, p 304-310, October, 1983. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Oxygen budget, *Aquatic plants, *Broa Reservoir, *Brazil, Standing crop, Photosynthesis, Algae, Diffusion, Respiration.

Daily oxygen budgets within a stand of submerged plants were measured in August, with the use of five cylindrical plastic tubes with different enclosure systems. The standing crop of living and dead plants at the experimental site was 47.9 and 37.5 g dry matter/sq m, respectively. Both daily total oxygen addition and that of oxygen loss in the water at the sand were estimated as 3.24 g O2/sq m/day. Daily gross productions of oxygen through photosynthesis by the submerged plants with their epiphytic algae and by epipelic algae accounted for 36% and 37% of the total oxygen addition, respectively. As much as 47% of the total loss was due to air released from water through diffusion, and 36% of that was due to total respiration. Both the daily amount of diffusion and its direction mainly depended upon the dissolved oxygen concentration at the researched water; daily amount of diffusion from water to air was estimated as 1.51 g O2/sq m/day, and the highest rate of oxygen diffusion was 0.21 g O2/sq m/hr for 12-15 hours, when the rate of net oxygen production of 0.32 g O2/sq m/hr was sustained. (Author's abstract)
W84-04168

2I. Water In Plants

EFFECTS OF WATER STRESS ON THE WATER RELATIONS OF PHASEOLUS VUL-

GARIS AND THE DROUGHT RESISTANT PHASEOLUS ACUTIFOLIUS,
Agricultural Research and Education Center, Lake Alfred, FL.
L. R. Parsons, and T. K. Howe.
Physiologia Plantarum, Vol. 60, No. 2, p 197-202, 1984. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Water stress, *Plant water potential, *Drought resistance, *Tepary bean, Leaves, Water potentials, Moisture deficiency.

Drought resistant plants can use sevaral mechanisms to postpone or tolerate dehydration. These include reduction of water loss by increased stomatal resistance, reduction of absorbed radiation by changes in leaf orientation, or reduction in leaf area. Mechanisms that tend to promote drought tolerance by maintaining turgor include osmotic adjustment, an increase in cell wall elasticity, or a decrease in cell size. The tepary bean (Phaseolus acutifolius Gray var. latifolius), a drought resistant species, was compared under water stress conditions with the more drought susceptible P. vulgaris L. cvs Pinto and White Half Runner (WHR). In order to better understand the basis for the superior drought resistance of tepary, this study was designed to determine the relationships among leaf water potential, osmotic potential, turgor potential, and relative water content (RWC). Plants were prestressed by withholding irrigation water. These stress pretreatments changed the relation between leaf water potential and relative water content of both species so that prestressed plants had lower water potentials than controls at the same leaf RWC. Tepary had lower water potentials at given RWC levels than Pinto or WHR; this can account for part of the superior resistance of tepary. In all genotypes, prestressed plants maintained osmotic potentials approximately 0.2 MPa lower than controls. Tepary reached osmotic potentials that were significantly lower (0.15 to 0.25 MPa) than Pinto or WHR. Both control and prestressed tepary plants had 0.05 to 0.25 MPa more turgor than Pinto or WHR at RWC values between 65 and 80%. Both prestressed and control tepary plants had greater elasticity (a lower elastic modulus) than Pinto or WHR. This greater turgor of tepary at low RWC values could be caused by several factors including greater tissue elasticity, active accumulation of solutes, or greater solute concentration. Tepary had significantly lower osmotic potentials than the P. vulgaris cultivars, but there was little difference in osmotic potential between Pinto and WHR. Knowledge of differences in osmotic and turgor potentials among and within species could be useful in breeding for drought resistance in Phaseolus. (Murphy-IVI)
W84-03870

GROWTH, WATER POTENTIAL AND ION ACCUMULATION IN THE INLAND HALOPHYTE ATRIPLEX TRIANGULARIS UNDER SALINE FIELD CONDITIONS,
Ohio Univ., Athens. Dept. of Botany.
T. E. Riehl, and I. A. Ungar.
Acta Oecologica-Oecologia Plantarum, Vol. 4, No. 1, p 27-39, 1983. 5 Fig, 5 Tab, 24 Ref. NSF grant DEB7927236.

Descriptors: *Plant growth, *Saline soils, *Atriplex, Water potentials, Plant water potential, Salt marshes, Sodium, Chlorides, Rittman, Ohio.

Atriplex triangularis, an annual halophyte in the family Chenopodiaceae, has a wide distribution but generally occurs in inland and coastal salt marshes. The effect of soil conditions on the growth and distribution of A. triangularis were investigated on an inland salt marsh at Rittman, Ohio. The study site consists of three zonal communities, each dominated by populations of a single species. Atriplex plants which grow adjacent to the Salicornia zone (Atriplex wet zone) are subjected to generally more saline and wetter soils than those growing nearer to Hordeum-Atriplex zone (Atriplex dry zone) or those growing with Hordeum jubatum (Hordeum-Atriplex zone). Plant dry matter production in the most highly saline habitats was less than 50% of that in the less saline sites. In the most saline environment, all plants were dead by the end of July prior to reaching the flowering stage. Increases in soil salinity were significantly correlated with increasing sodium and chloride ion content and more negative water potentials in roots and shoots of A. triangularis. High plant densities also reduced dry weight production in A. triangularis. (Baker-IVI)
W84-03872

EFFECTS OF WATER AND NITROGEN SUPPLY ON THE COMPETITION BETWEEN THREE PERENNIAL MEADOW GRASSES,
California Univ., Irvine. Dept. of Ecology and Evolutionary Biology.
M. R. Sharifi.
Acta Oecologica-Oecologia Plantarum, Vol. 4, No. 1, p 71-82, 1983. 4 Fig, 3 Tab, 36 Ref.

Descriptors: *Meadows, *Plant growth, *Grasses, *Nitrogen, *Water supply, Stress, Bromus, Alopecurus, Arrhenatherum, Groundwater.

The biomass production with and without competition of Alopecurus pratensis, Arrhenatherum elatius, and Bromus erectus was examined in lysimeter experiments using three different levels of nitrogen fertilization and water supply. Alopecurus was the strongest competitor under almost all conditions, while Bromus was the weakest competitor. The success of Arrhenatherum in mixed culture varied with ground water level and nitrogen fertilization. The physiological behavior of Alopercurus was similar to its ecological behavior. Arrhenatherum was forced into drier, nitrogen-poorer conditions by Alopecurus. Bromus was encroached upon by both other species under all conditions. The concept of competition and its effects on the ecological behavior of these three species is discussed. The major conclusion was that while stress tolerators such as Bromus erectus, grow in areas where there is competition, they grow much better in stress free situations. (Baker-IVI)
W84-03873

WATER STRESS AND TREE PHENOLOGY IN A TROPICAL DRY FOREST IN THE LOWLANDS OF COSTA RICA,
P. B. Reich, and R. Borchert.
Journal of Ecology, Vol. 72, No. 4, p 61-74, March, 1984. 3 Fig, 34 Ref.

Descriptors: *Water stress, *Trees, *Phenology, *Costa Rica, Tropical region, Seasonal variation, Plant growth, Plant water potential, Available water.

It has long been recognized that seasonal changes in the physiognomy of tropical forests are caused primarily by seasonal variation in rainfall, which in conjunction with soil moisture availability is the principal determinant of tree water status. Phenology and seasonal variations in water stress, as indicated by variations in girth, were monitored for 1 yr in numerous trees of twelve species, growing at dry and moist sites in a tropical lowland deciduous forest in Guanacaste, Costa Rica. At dry sites, trees experienced water stress and shed their leaves early in the dry season. In most species, rehydration, followed by bud break, took place only after heavy rainfalls. In some species, leaf shedding was followed by rehydration and bud break during continuing drought. During shoot extension, which rarely lasted longer than a few weeks, trees experienced water stress in spite of growing in wet soils. At wet sites, trees experienced little or no apparent water stress; they remained evergreen or rapidly exchanged leaves during the dry season. In general, the timing of leaf fall and bud break and, in many species, anthesis was determined to a large extent by changes in tree water status. These phenomena, in turn, were a function of the interaction between the water status of the environment and the structural and functional state of the tree. At times the functional state of the tree would counteract the environmental influences; trees with growing shoots experienced temporary water deficits during the wet season, and bare trees rehydrated during drought. The seasonal pattern of tree development had a high correlation with seasonal variation in tree water status, but only indirectly with environment water availability. No evidence was found for the control of tree development by seasonal variation in photoperiod or temperature. (Murphy-IVI)
W84-03950

WATER RELATIONS OF DACTYLIS GLOMERATA AND DICHANTHIUM ISCHAEMUM CULTIVATED UNDER TWO DIFFERENT WATER REGIMES (RELATIONS HYDRIQUES CHEZ DACTYLIS GLOMERATA ET DICHANTHIUM ISCHAEMUM CULTIVES SOUS DEUS REGIMES HYDRIQUES CONTRASTES),
Thessalonika Univ., Salonika (Greece). Lab. de Science des Paturages.
B. Noitsakis, and A. Berger.
Acta Ecologia, Vol. 5, No. 1, p 75-88, 1984. 8 Fig, 3 Tab, 33 Ref.

Descriptors: *Plants, *Water stress, *Dactylis, *Dichanthium, Stomata, Temperature effects, Hydrologic budget.

The relative occurrence of the two plant types, C3 species and C4 species, has most often been related to their different responses to temperature. Responses to water stress have recently been investigated in Dactylis glomerata (C3) and Dichanthium ischaemum (C4). Water balance by the C3 species is characterized mainly by a regulation of stomatal conductance, which shows a plastic response to water stress. The C4 species is characterized by high root and stem conductance and by a low plasticity of stomatal regulation. Hydrodynamic characteristics of the leaves are plastic in both species. The C3 species response is likely controlled more by photoperiod than by water stress while that of the C4 species is independent of photoperiod but is controlled by water stress. (Baker-IVI)
W84-04058

SOIL AND XYLEM WATER POTENTIAL AND SOIL WATER CONTENT IN CONTRASTING PINUS CONTORTA ECOSYSTEMS, SOUTHEASTERN WYOMING, USA,
Wyoming Univ., Laramie. Dept. of Botany.
T. J. Fahey, and D. R. Young.
Oecologia, Vol. 61, No. 3, p 346-351, March, 1984. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Soil water, *Soil water potential, *Soil-water-plant relationships, *Xylem water potential, *Pine, *Wyoming, Water stress, Rhisosphere moisture, Soil porosity, Soil structure.

The relationships between volumetric soil water content (theta), in situ soil water potential (psi soil) and predawn xylem pressure potential (psi predawn) were quantified in four contrasting lodgepole pine ecosystems in Wyoming, USA. On three of the sites, changes in psi soil correlated closely with psi predawn, but on a porous soil derived from coarse granitic parent material, psi predawn declines occurred much sooner than corresponding declines on psi soil, possibly because of local depletion of rhizosphere moisture and low molecular diffusivity of water in that soil. Extrapolation of laboratory-derived characteristic curves for soil moisture to field conditions yielded different relationships between theta and psi soil than curves derived from in situ measurements, probably because of disruption of soil structure and porosity during samples collection and handling in laboratory studies. Although a close correlation between theta and psi predawn was observed, future efforts at modelling the soil-plant-atmosphere continuum should be directed towards a more detailed understanding of the complex relationships between psi soil at varying depths and plant water stress. (Author's abstract)
W84-04175

WATER LOSS AND MALATE FLUCTUATIONS DURING THE DAY FOR PLANTS IN THE SOUTHERN NAMIB DESERT,
Bayreuth Univ. (Germany, F.R.).
D. J. v. Willert, E. Brinckmann, B. M. Eller, and B. Scheitler.
Oecologia, Vol. 61, No. 4, p 393-397, March, 1984. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Desert plants, *Water loss, *Transpiration, *Namib desert, Photosynthesis, Leaf conductance, Malate, Succulence.

The daily course of transpiration for 12 different plants growing in the southern Namib desert was investigated. Sclerophyllous species with C3 photosynthesis were the most effective water savers followed by succulents exhibiting CAM, while C3 pathway-succulents lose as much water as malacophyllous species. The different species showed either one or two peaked patterns of both transpiration and leaf conductance. With C3 plants the most common pattern is a single morning peak in leaf conductance followed by decreases in conductance over the remainder of the day. With CAM succulents leaf conductance is high in the morning, shows a pronounced midday depression and increases in the early afternoon when the malate pool is depleted, but malate consumption did not start earlier than 4 h after dawn. Seven of nine investigated C3 plants had rather high contents of malate, up to 180 micromol/g dry matter. In these plants the malate content increased with increasing leaf conductance and disappeared when leaf conductance declined in the evening, indicating that malate was synthesized during photosynthesis. (Author's abstract)
W84-04176

2J. Erosion and Sedimentation

DEBRIS FLOW HAZARD ASSESSMENT FOR THE OREGON CAVES NATIONAL MONUMENT,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2G.
W84-03577

PRELIMINARY SEDIMENT NETWORK EVALUATION FOR THE PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-03585

MEASUREMENT OF BEDLOAD DISCHARGE IN NINE ILLINOIS STREAMS WITH THE HELLEY-SMITH SAMPLER,
Geological Survey, Urbana, IL. Water Resources Div.
J. B. Graf.
USGS Water-Resources Investigations Report 83-4136, 1983. 70 p, 10 Fig, 28 Tab, 11 Ref.

Descriptors: *Bedload discharge, *Sediment transport, *Fluvial sediments, Rivers, Sampling, *Helley-Smith bedload sampler, *Bedload discharge rating curves, *Illinois.

Samples collected with the Helley-Smith bedload sampler provide useful information about transport of sand-size sediment in Illinois streams. Samples provide the basis for bedload-discharge rating curves for the Rock and Kaskaskie Rivers and Henderson Creek. Comparison of measured bedload discharge with bedload discharge computed for selected flow conditions from channel characteristics allows the selection of an appropriate indirect method for determining bedload discharge for the Spoon, Kishwaukee, and Edwards Rivers. No one indirect method best represents bedload discharge in studied streams. No bedload-discharge rating curve was developed for the La Moine River, because the two measured bedload discharges are not sufficient for development of a rating curve and do not agree well with discharges computed by any of the three indirect methods. The dominant size of bedload particles in all streams sampled give results which cannot be used at this time. Collection-bag clogging may have been significant in the Green River, and large bed material gains or high flow velocities may have interfered with the operation of the sample in the Vermilion River. (USGS)
W84-03590

PRINCIPLE AND APPLICATION OF SEDIMENT EFFECTIVE POWER,
Tianjin Univ. (China). Dept. of Hydraulic Engineering.
S-Y. Wang.
Journal of Hydraulic Engineering (ASCE), Vol. 110, No. 2, p 97-107, February, 1984. 5 Fig, 4 Tab, 13 Ref. NSF grant ENG 7825054.

Descriptors: *Sediment effective power, Mathematical models, Sediment-water interfaces, Sediment transport, Open channel, Bed load, Sediment concentration, Sediment-carrying capacity, Flow.

From an energy analytical standpoint, the energy which can support the sediment load of streamflow in suspension is considered only a part of the total energy loss in the streamflow. The concept of potential velocity is introduced to explain the principle of sediment effective power. From the principle of effective power of sediment consideration, an equation has been developed for calculating the variation of the von Karman constant in sediment-laden flow. On this basis, a new classification of moving sediment in an open channel is suggested and a description of the applications to river sedimentation is presented. The variation of von Karman constant in sediment-laden flow, the distinction between wash load and bed-material load, as well as the adequacy of sediment transportation formulas are reviewed. (Murphy-IVI)
W84-03716

FORMATION AND EFFECTS OF ALTERNATE BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 8B.
W84-03719

MODELING OF RIVER CHANNEL CHANGES,
For primary bibliographic entry see Field 8B.
W84-03720

INDUS PARADOX,
National Inst. of Oceanography, Panaji (India).
For primary bibliographic entry see Field 8D.
W84-03729

EROSION AND SEDIMENT TRANSPORT IN THE GANGES RIVER BASIN (INDIA),
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
N. Abbas, and V. Subramanian.
Journal of Hydrology, Vol. 69, No. 1, p 173-182, February, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Erosion, *Sediments, *India, *Ganges River, Sedimentation, Sediment transport, Sediment load, Denudation, River basins.

Based on the observed erosion rates, the Ganges river system would reach mean sea level in about 4,000,000 yr. However, some of the sub-basins have much higher rates, such as 8,000,000 yr for the Yamuna basin. The basement of the Ganges basin lies below the 6 km thick alluvium. Such a great thickness requies a continuous supply of sediments for at least the past 5,000,000 yr. Thus, the calculated time for basin activity should be corrected for compensating mechanisms such as uplift before the life of a basin can be determined. Annual decrease in basin elevation indicates a rapid process of denudation and such rates have a bearing on rates of shelf sediment accumulation. (Baker-IVI)
W84-03782

SUSPENDED MATTER, MAJOR CATIONS AND DISSOLVED SILICON IN THE ESTUARINE WATERS ON THE MAHANADI RIVER, INDIA,
Utkal Univ., Bhubaneswar (India). Dept. of Geology.
S. B. Ray, M. Mohanti, and B. L. K. Somayajulu.
Journal of Hydrology, Vol. 69, p 183-196, 1984. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Suspended matter, *Cations, *Dissolved silicon, *Estuaries, *Mahanadi River, *India, Sodium, Potassium, Magnesium, Calcium, Silicon, Trace metals, Sediment transport, Bay of Bengal, Monsoons, Sediment concentration.

A knowledge of suspended and soluble inputs from rivers to the ocean as well as their major- and trace-elemental composition is essential for calculating material balances for various elements and to find out their possible sinks and sources. Results of extensive measurements of suspended matter, major cations Na, K, Mg, Ca and dissolved Si in the waters of the Mahanadi estuary during seven sampling periods between 1977 and 1981 are reported. The particulate concentrations ranged from 0.6 to 596 mg/l during all sampling periods with the highest concentrations occurring in the monsoon season. The mean annual suspended load from the Mahanadi is estimated to be 1.4 x 10 to the 17th power g, almost all of which is monsoonal contribution. Na, K and to a large extent Mg and Ca behave conservatively in the estuary and their annual dissolved fluxes to the Bay of Bengal are: 2.6 x 10 to the 15th power, 7 x 10 to the 14th power, 1.3 x 10 to the 15th power and 4.2 x 10 to the 15th power g, respectively. Si behaves non-conservatively, there is a net removal of 11% of the total annual dissolved Si supply of 3.3 x 10 to the 15th power g to the Bay of Bengal. A major part of this removal occurs during the winter months and appears to be biological. (Murphy-IVI)
W84-03783

GUIDE TO THE LARVAE OF THE NEARCTIC DIAMESINAE (DIPTERA:CHIRONOMIDAE): THE GENERA BOREOHEPTAGYIA, PROTANYPUS, DIAMESA, AND PSEUDOKIEFFERIELLA,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03848

CHARACTERISTICS OF SUSPENDED SEDIMENT IN THE SAN JUAN RIVER NEAR BLUFF, UTAH,
Geological Survey, Salt Lake City, UT. Water Resources Div.
K. R. Thompson.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $3.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4104, 1982. 21 p, 8 Fig, 3 Tab, 5 Ref.

Descriptors: *Fluvial sediment, *Sediment concentration, Discharge, Sediment load, Sediment sampler, *Colorado River basin, San Juan River basin.

Fluvial-sediment data were collected for the San Juan River near Bluff beginning in 1914 and terminating in 1980. A double-mass curve showed a change in relationship between annual suspended-sediment discharge and annual stream discharge between the water years 1941-44 and 73. Possible causes for these changes in laboratory procedures, and unusually large runoff that occurred in 1941 and 1972. An unknown or unidentified factor may also be involved. The actual reason for this change in relationship may never be fully understood. Navajo Dam apparently has had no significant effect on fluvial sediment at the sampling site. Mean annual suspended sediment discharge in the San Juan River near Bluff was about 25,410,000 tons ranging from 3,234,000 tons in 1978 to 112,400,000 tons in 1941. The use of annual stream discharge to predict annual suspended-sediment discharge at the site will produce poor results because of size and diversity of the basin and the quality of records available. A positive correlation exists between sand concentration and stream discharge at this site, however, considerable variability is evident. This relationship does not exist when stream discharge exceeds 6,000 cubic feet per second. It is recommended that if collection of suspended-sediment records be resumed in this reach of the river an alternative sampling site should be selected and the use of pumping sam-

plers considered because of the remoteness of the area. (USGS)
W84-03851

MUDFLOW HAZARDS ALONG THE TOUTLE AND COWLITZ RIVERS FROM A HYPOTHETICAL FAILURE OF SPIRIT LAKE BLOCKAGE,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03856

FORMATION OF PERYLENE IN RECENT SEDIMENTS: KINETIC MODELS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
P. M. Gschwend, P. H. Chen, and R. A. Hites.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2115-2119, December, 1983. 1 Fig, 1 Tab, 21 Ref. NSF grant OCE-80-05997, DOE grant 80-EV-10449.

Descriptors: *Hydrocarbons, *Sedimentology, *Ponds, *Sediments, *Perylene, Mountain Pond, Maine, Chemical reactions, Kinetics.

Perylene is a pentacyclic aromatic hydrocarbon which has been found in many recent sediments. The concentration of perylene increased regularly with depth in a radiometrically dated sediment core from Mountain Pond, Coburn Mountain, Maine. This high altitude pond is small, shallow and oligotrophic. The location of the pond precludes large interfering inputs of anthropogenic perylene or perylene from weathered rocks. This concentration profile was fit to simple reaction kinetic models which indicate that perylene forms in this core either by a first order reaction characterized by a rate constant of 0.012/yr or by a second order reaction characterized by a rate constant of 0.0013 nmole/g/yr. Such perylene data may be used to judge the constancy, not only of amount but also of kind, of organic matter accumulated. The depth of initial perylene formation may indicate an important reductive horizon in the core while a regularly increasing perylene profile may demonstrate that the anoxic conditions have not varied. Analysis of perylene is not difficult and does not appear to be influenced by sampling or storage artifacts. Thus, perylene could be a very useful geochemical indicator. (Baker-IVI)
W84-03863

MIXING RATES IN SHAGAWA LAKE, MINNESOTA, SEDIMENTS AS DETERMINED FROM 106-RU PROFILES,
Oregon State Univ., Corvallis. School of Oceanography.
J. Van Sickle, W. C. Weimer, and D. P. Larsen.
Geochimica et Cosmochimica Acta, Vol. 47, No. 12, p 2189-2197, December, 1983. 3 Fig, 3 Tab, 36 Ref.

Descriptors: *Lake sediments, *Minnesota, *Shagawa Lake, *Mixing, Radioisotopes, Ruthenium, Sediments, Cesium, Lead, Enrichment, Bioturbation.

Rates of surficial sediment mixing and sediment burial are measured in Shagawa Lake, Minnesota, using radionuclide tracers. Based on Ru-106 profiles in 16 cores, mixing rates average 13 sq cm/yr within the upper 9 cm of sediment. Two other nuclides, Pb-210 and Cs-137, provide further evidence for calculation of mixing rates. In addition, Pb-210 profiles estimate sediment burial rates (about 0.4 cm/yr). Mixing estimates are shown to be fairly insensitive both to uncertainties in sediment burial rates and to temporal patterns of Ru-106 deposition. Results suggest that the deeper sediments in the lake were laid down and buried for some distance during a period of little mixing. Near-surface sediment reworking is likely due to bioturbation. Thus it is reasonable to hypothesize that the benthic fauna, along with its mixing effects, was meager prior to 1900, but has increased greatly since in response to Shagawa Lake's rapid enrichment. (Baker-IVI)
W84-03864

PROCESS OF SEDIMENTATION ON THE SURFACE OF A SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
R. P. Stumpf.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 5, p 495-508, November, 1983. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Sedimentation, *Salt marshes, Sediment transport, Sediment size, Holland Glade Marsh, Lewes, Delaware.

An unditched salt marsh-creek drainage basin (Holland Glade Marsh, Lewes, Delaware) has a sedimentation rate of 0.5 cm/year. During normal, storm free conditions, the creek carries negligible amounts of sand and coarse silt. Of the material in the waters flooding the marsh surface, over 80% disappears from the floodwaters within 12 m of the creek. About one-half of the lost material is theoretically too fine to settle, even if flow were not turbulent; however, sediment found on Spartina stems can account for the loss. The quantity of suspended sediment that does reach the back marsh during these normal tides is inadequate to maintain the marsh surface against local sea level rise. This suspended sediment is also much finer than the deposited sediments. Additionally, remote sections of low marsh, sections flooded by only the highest spring tides, have 15-30 cm of highly inorganic marsh muds. This evidence indicates that normal tide flooding does not produce sedimentation in Holland Glade. Study of the effects of two severe storms, of a frequency of once per year, suggests that such storms can deposit sufficient sediment to maintain the marsh. The actual deposition of the fine-grained sediments (fine silt and clay) appears to result primarily from biological trapping rather than from settling. In addition, this study proposes that the total sedimentation on mature marshes results from a balance between tidal and storm sedimentation. Storms will control sediment supply and movement on micro- and meso-tidal marshes, and will have less influence on macro-tidal marshes. (Author's abstract)
W84-03897

IMPROVED NUMERICAL MODEL FOR SEDIMENTATION,
Hochschule der Bundeswehr, Munich (Germany, F.R.). Faculty of Civil Engineering.
W. Bechteler, and W. Schrimpf.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 234-246, March, 1984. 7 Fig, 1 Tab, 10 Ref.

Descriptors: *Mathematical model, *Sedimentation, Mathematical equations, Settling tanks, Dimensional analysis, Wastewater treatment, Diffusion coefficient.

The sedimentation process is an important aspect of the planning and running of many hydraulic and sewage plants. An improved method is developed for the practical dimensioning of horizontal settling tanks. Using this method completed diagrams can be provided to determine the necessary settling lengths for every given removal ratio. The concerned differential equation is solved by a numerical method which can avoid numerical diffusion, therefore predicting more accurately removal ratios in settling basins. Also, concentration profiles and diagrams for dimensioning retarding basins can be computed for different initial and boundary conditions. The flexibility of the model is of practical value with regard to various inlet concentrations and velocity profiles that can be considered. (Murphy-IVI)
W84-03918

SEDIMENT TRANSPORT FORMULA FOR STEEP CHANNELS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. M. Smart.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 267-276, March, 1984. 4 Fig, 3 Tab, 9 Ref.

Descriptors: *Mathematical equations, *Sediment transport formula, *Steep channels, Sedimentation, Sedimentation rates, Meyer-Peter Mueller equation, Comparison studies, Slopes.

A description is given and results presented of experiments to investigate the sediment capacity of stream flows on flume slopes of up to 20%. A comparison of the results with values predicted by the Meyer-Peter Mueller equation shows that the latter equation seriously underestimates sediment transport capacity on slopes steeper than 3%, mainly because of deficiencies in the form resistance factor. A new equation is proposed, giving the transport capacity for materials with grain sizes larger than 0.4 mm (0.016 in.). The equation is calibrated by both the original Meyer-Peter data and new steep flume experiments and modified to incorporate the effect of nonuniform sediment grain size distributions. With flow depths calculated by the Manning-Strickler equation the new equation still gives excellent estimates of sediment capacity. (Author's abstract)
W84-03919

BED LOAD TRANSPORT OF COARSE NONUNIFORM SEDIMENT,
Regional Engineering Coll., Srinagar (India).
R. L. Misri, R. J. Garde, and K. G. Ranga Raju.
Journal of Hydraulic Engineering, Vol. 110, No. 3, p 312-328, March, 1984. 13 Fig, 1 Tab, 22 Ref.

Descriptors: *Bed load, *Sediment transport, *Coarse sediments, Nonuniform Sediments, Sedimentation, Mathematical models, Mathematical equations, Comparison studies.

A model of bed load movement may be conceived on the assumption that lift is the predominant force influencing the motion of particles smaller than the arithmetic mean size, d sub a, since these particles are hidden in the wakes of the larger particles. Both drag and lift are assumed to affect the motion of the coarser particles. Four coarse uniform materials and 9 sediment mixtures were used as the bed material. There was good agreement only with Einstein's relation when a comparison was made between other bed load relations. A conceptual model for the effect of a particular size of sediment on the transport rates of other sizes of sediment is proposed. The experimental data are analyzed with the dual objectives of assessing the accuracy of existing methods of computation of bed load transport and of proposing a new method of computation. (Murphy-IVI)
W84-03923

SOURCES AND DISTRIBUTIONS OF SEDIMENTARY ORGANIC MATTER IN THE COLUMBIA RIVER DRAINAGE BASIN, WASHINGTON AND OREGON,
Washington Univ., Seattle. School of Oceanography.
J. I. Hedges, H. J. Turin, and J. R. Ertel.
Limnology and Oceanography, Vol. 29, No. 1, p 35-46, January, 1984. 4 Fig, 3 Tab, 33 Ref. NSF grants OCE 80-23970 and DEB 79-12241.

Descriptors: *Sediments, *Organic matter, *Drainage basins, *Columbia River, *Washington, *Oregon, Basins, Sediment transport, Angiosperms, Gymnosperms, River basins, Lignins, Vegetation.

The Columbia is one of the major river systems of the world with a total drainage basin of 670,000 sq km and a mean annual discharge of 7,200 cu m/s. Nonwoody angiosperm tissues and gymnosperm woods are the major types of vascular plant debris in bottom sediments from 16 sites within the Columbia River and its tributaries. There is a clear relationship between geographic trends in local vegetation and the sedimentary lignin composition of the Columbia River tributaries. In the extensively dammed main river, the vascular plant debris mixtures are more uniform, thus indicating downstream mixing of sedimentary material from reservoir to reservoir. Vascular plant tissues account for an average of a third of the total sedimentary organic matter at the 16 river sites. The remaining organic material has an atomic C:N of 10-15 and a stable carbon isotope composition similar to average land plants. Organic matter in sediments of the Columbia River system is generally enriched in nonwoody angiosperm tissues and lignin-poor or-

ganic matter in comparison to Columbia River derived organic matter in modern marine sediments from the southern Washington continental shelf. (Baker-IVI)
W84-03960

TRANSPORT AND BREAKDOWN OF FECAL PELLETS: BIOLOGICAL AND SEDIMENTOLOGICAL CONSEQUENCES,
Washington Univ., Seattle. School of Oceanography.
G. L. Taghon, A. R. M. Nowell, and P. A. Jumars.
Limnology and Oceanography, Vol. 29, No. 1, p 64-72, January, 1984. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Benthic environment, *Sediment transport, *Fecal pellets, Benthos, Aquatic life, Benthic fauna, Aquatic animals, Worms, Feces.

Direct and independent measurements were taken of the densities, sizes, and settling velocities of fecal pellets produced by Amphicteis scaphobranchiata, a deposit-feeding polychaete worm. Pellet density was measured by an isosmotic density gradient technique. Densities ranged from 1.086 to 1.282 g/cu cm and settling velocities from 3.03 to 5.94 cm/sec. Pellets were transported as bedload for variable distances. The oldest pellets tested were 6 hr after production. These traveled a median distance of 3.1 m. Freshly egested pellets traveled 9.5 m before disintegrating. While worms would reingest disaggregated pellets, feeding rates correlated positively with pellet age, consistent with earlier findings that this species feeds at a faster rate on energetically more profitable sediment. Substantial interactions among benthic animals, fecal pellets, and the processes of sediment transport are thus verified. (Baker-IVI)
W84-03961

SEDIMENTATION PROBLEMS IN RIVER BASINS,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
A. Sundborg.
Nature and Resources, Vol. 19, No. 2, p 10-21, April-June, 1983. 12 Fig, 1 Tab, 7 Ref.

Descriptors: *Erosion control, *Sedimentation, *River basins, Erosion, Rainfall-runoff relationships, Land use, Agriculture, Sediment transport, Forest management.

In 1975 under the International Hydrological Programme, a project was established to investigate the relationship between sedimentation and erosion on the one hand, and fishing, forestry, wildlife, agriculture, grazing, mining and construction work on the other. The international dimensions of the environmental problems involved are discussed. Man's use of the land can result in accelerated erosion and deposition, river migration, channel-regime changes and many other effects. Problems can occur in three different environments: the source area delivering the material, the river channel system forwarding the load, and the depositional environment, where the particles come to rest. The purpose of taking corrective measures for the control of erosion and sedimentation processes is to reduce or eliminate negative effects. The evaluation of economic losses due to soil erosion and sedimentation problems is a complicated procedure. Actual costs are easy to calculate for specific soil conservation measures and for hydraulic structures in rivers. However, it is more difficult to evaluate costs in economic terms of losses caused by soil deterioration in the upper river basin. International cooperation in soil conservation efforts is needed. (Baker-IVI)
W84-03970

UNSTEADY SEDIMENTATION IN NONUNIFORM RILLS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II, and G. R. Foster.
Journal of Hydrology, Vol. 70, No. 1-4, p 101-122, 1984. 14 Fig, 1 Tab, 4 Ref.

Descriptors: *Sedimentation, *Runoff, *Rill flow, *Interrill flow, Kinematics, Mathematical models, Overland flow, Hydraulic models, Soil erosion.

The objective of the field study was to measure, very frequently, runoff rate and sediment concentration precisely, until both reached equilibrium. The model being validated assumes a system of parallel ridges and furrows where rill and interrill areas can be precisely defined. The experiments were conducted on a silt-loam soil on a 5% slope. Constant intensity rainfall was applied with a rainfall simulator having impact velocities near those of natural rainfall. The kinematic unsteady overland sedimentation theory of prismatic channels is extended to the experiments by considering both hydraulics and sediment dynamics of rill flow for changing flow geometries of nonuniform and unsteady rill development. The characteristic unimodal concentration peak observed in the experiments and the changing geometry were interpreted in theoretical terms. Overland sedimentation in unsteady nonprismatic rills under uniform rainfall can be described with kinematic models of flow, entrainment and deposition applied to developing flow geometries; this is not possible with sheet-flow models. The hydraulic and sedimentation results are consistent in that each points to the existence of nonprismatic channel developments. The rills develop from deep and narrow, upstream to wide and shallow in the downstream direction, resulting in velocity reduction with increasing flow that is reflected in both the hydraulic analysis and the sedimentation analysis. (Moore-IVI)
W84-04145

2K. Chemical Processes

THERMAL SPRINGS IN THE BOISE RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03588

ACID PRECIPITATION: THINGS ONE CAN DO - THE TUG HILL COMMISSION APPROACH,
New York State Temporary Commission on Tug Hill, Watertown.
D. J. Beevers.
Report, October, 1982. 24 p, 3 Fig, 9 Ref, 1 Append.

Descriptors: *Acid rain, *Public policy, *Public participation, *Environmental policy, Long-term planning, Legislation, Public opinion, Regional planning, Water quality, Economic impact.

Acid precipitation is an international problem requiring more knowledge of its causes and effects, increased public awareness, and national policies to address it. New York's Temporary Tug Hill State Commission, with limited budget, small staff, and only regional jurisdiction, has sought to learn and provide information about acid precipitation and to impact public policy. Only a limited amount of basic research has been conducted in the Tug Hill area, which encompasses 1.3 million acres in 39 towns in portions of four counties. Acid precipitation data collected from four U.S.G.S. monitoring stations (Canton, Stillwater, Hinkley, May's Point) surrounding the area and the National Atmospheric Deposition Program station at Bennett Bridge within the Tug Hill study area, as well as other data, indicate that the area receives a large quantity of highly acidic precipitation. For example, the average lab pH for 22 samples taken at Bennett Bridge between June and December 1980 (the only data available) was 4.09. Some red spruce and red maple die-back may be linked to acid precipitation. The Commission has implemented a variety of activities in response, including use of students to survey acid precipitation, policy statements, research projects on water quality and forest impacts, and design and implementation of a public opinion survey that may lead to additional public awareness, legislative action, and research. Most of these are relatively low-cost activities that similar agencies or other groups could participate in or initiate. (Fazio-Omniplan)
W84-03656

ACID PRECIPITATION AND THE SALMON RIVER SYSTEM, TUG HILL, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto, and P. Dentice.
Report, Temporary State Commission on Tug Hill, February, 1977. 49 p, 6 Fig, 6 Tab, 27 Ref, 1 Append.

Descriptors: *Acid rain, *Acid streams, *Chemistry of precipitation, *Acidity, Water sampling, Macroinvertebrates, Areal precipitation, Chemical analysis, Hydrogen ion concentration, Sulfates, Nitrates, Alkalinity, Calcium.

Possibly one of the most serious consequences of this country's tremendous utilization of energy resources could be the acidification of land and water in the northeastern United States as a result of the emission, transport, oxidation and hydrolysis, and deposition of sulfur oxides and nitrogen oxides produced in the consumption of fossil fuels. In accordance with the study's objective of concentrating on Salmon River's water quality, eight sampling sites in the watershed were selected. Precipitation was collected on a bulk basis (wet and dry fallout). The same parameters measured for precipitation samples were analyzed for stream samples, the precipitation on Tug Hill appears to be at least as acidic as the rest of the northeastern United States and in many cases the annual hydrogen ion loading will be higher because of the quantity of precipitation in the area. The chemical and biological water quality of the streams in the Salmon River watershed is quite good and is capable of maintaining a diverse and productive macroinvertebrate community. The system does not appear to have been severely affected by acid rain to date and appears to be in no immediate danger; however, the system may experience long-term deterioration due to continued high acid inputs. Some short-term, event-associated decreases in stream pH were observed, but it is unlikely that these occurrences have cumulatively affected the biota. (Fazio-Omniplan)
W84-03658

FEDERAL PLAN FOR MITIGATION OF ACID PRECIPITATION EFFECTS IN THE UNITED STATES: OPPORTUNITIES FOR BASIC AND APPLIED RESEARCH,
For primary bibliographic entry see Field 6E.
W84-03812

SEQUENTIAL SAMPLING AND VARIABILITY OF ACID PRECIPITATION IN HAMPTON, VIRGINIA,
National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.
G. L. Pellett, R. Bustin, and R. C. Harriss.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 33-49, January, 1984. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Acid rain, *Hampton, *Virginia, Air pollution, Fallout, Air pollution effects, Hydrogen ion concentration, Sulfate, Nitrate, Water pollution, Atmospheric physics, Chemistry of precipitation.

To resolve questions concerning the origin and ecological significance of acid precipitation, major research programs have been initiated in most regions of the world, including the development of nationwide and worldwide precipitation chemistry monitoring networks. Data was taken for a 3-year study of the intraevent volume-resolved variability of pH, sulfate, and nitrate in precipitation at a relatively isolated surburban site in Hampton, Virginia. Rain samples were collected sequentially by amount (approximately 2.7 mm each) from individual events. Rain pH's for $<$ or $=$ 3 mm samples closely fit a monomodal Gaussian distribution with a median of 4.50 and a standard deviation of 0.39. The variability in pH was primarily interevent as opposed to intraevent. The 3-yr volume-weighted

pH was 4.35 + or - 0.02 for 3.16 m collected; annual pH's were 4.31, 4.37, and 4.38, and cumulative H(+) deposition was 141 mg H(+)/sq m. Event-averaged rain pH and meteorological and air quality data were correlated. Low pH was associated with low rainfall volume and rate; rain after several dry days; rains with northeast surface winds; high SO2, NO2 and O3 in the ambient atmosphere; and high, strongly correlated, SO4(2-) and NO3(-) rainwater concentrations. The lowest 3-yr seasonal average pH (4.31) occurred during the summer; values for other seasons were approximately 4.37. It is considered climatologically significant that the volume-weighted H(+) concentrations of sequential samples, for all events, were very well characterized as a function of cumulative rainfall by a power-law fit (exponent = -0.22). Furthermore, as a consequence, event-averaged H(+) deposition varied as the 0.78 power of event volume. While the former result differs from the assumption of linear proportionality sometimes used in the literature, it deviates less from unity than a recent plot of MAP3S data on average SO4(2-) concentration per event, versus rainfall amount. (Murphy-IVI)
W84-03829

SUMMERTIME STUDY OF ACID DEPOSITION IN THE DETROIT AREA,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch, S. H. Cadle, and G. T. Wolff.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 51-60, January, 1984. 9 Fig, 7 Tab, 23 Ref.

Descriptors: *Acid rain, *Detroit, Chemistry of precipitation, Hydrogen ion concentration, Atmospheric physics, Deposition, Warren, Lapeer, Michigan.

A comprehensive acid-deposition measuring (June-September 1981 period) station has been set up at the General Motors Technical Center site in Warren, Michigan. A second station is also being operated at a rural site near Lapeer, Michigan, which is approximately 54 km north of the Warren site. The rain composition was similar at both sites with the pH averaging 4.1 and the SO4(2-)/NO3(-) equivalence ratio averaging 2.1:1. This similarity suggests that local sources, i.e., relatively high emissions near the Warren site, and low emissions near the Lapeer site, have little effect on rain composition. The SO4(2-)/NO3(-) ratio for individual rain events in Warren reflected the SO2/NOx emission ratio in the area from which the event had come. Thus, the highest SO4(2-)/NO3(-) ratios were observed for rains that arrived from the southwesterly direction during this sampling period. Measurements were carried out at both sites to estimate the relative contribution of dry deposition. The ambient particulate was acidic about half the time and basic half the time. The acidity in the particulate was due to acid SO4(2-) and the basicity was due to soil-related materials. Gaseous HNO3 averaged 2.0 microg/cu m while the basic gas, NH3, averaged 0.83 microg/cu m. Based on these measurements, dry deposition of particles and HNO3 contributed less than 10% of the total deposition of acidity during this study period. (Murphy-IVI)
W84-03830

AEROSOL AND PRECIPITATION CHEMISTRY RELATIONSHIPS AT BIG BEND NATIONAL PARK,
Arizona Univ., Tucson. Dept. of Chemistry.
M. R. Derrick, J. L. Moyers, K. A. Yarborough, and M. Warren.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 171-181, January, 1984. 4 Fig, 3 Tab, 14 Ref.

Descriptors: *Aerosols, *Chemistry of precipitation, Air pollution effects, Sulfate, Nitrate, Ammonium, National Parks, Big Bend, Texas, Water pollution sources.

Aerosol chemistry, precipitation and visibility parameters are currently being measured at Big Bend National Park in Texas. This is part of a large-scale air resource evaluation program which the National Park Service is sponsoring in several southwestern national parks and monuments to determine the potential impact of local and distant pollutant sources on the environmental quality within these areas. Analysis of aerosol samples collected at six sites in the Southwest indicates that soil-derived components, organic materials and the acid-base ions of sulfate, nitrate, and ammonium are the major constituents of suspended airborne particulate matter in the remote areas of the arid region. Comparison of particulate matter chemistry and precipitation chemistry data at Big Bend National Park shows consistent features which indicate that the airborne alkaline soil material and NH3 largely neutralize the atmospheric acidic species of H2SO4 and HNO3. This buffering effect of the soil on the precipitation samples indicates that the impact of acidic precipitation on the ecosystem in the region is minimal. Given the similarity of the particulate matter composition and loading at the other monitoring sites, it is suggested that the trace chemical composition of precipitation will be similar in many remote regions of the Southwest. (Murphy-IVI)
W84-03832

CHEMICAL STRATIFICATION IN THE SENECA/OSWEGO RIVERS (NY),
Upstate Freshwater Inst., Syracuse, NY.
S. W. Effler, J. M. McCarthy, K. W. Simpson, F. J. Unangst, and G. C. Schafran.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, January, 1984. 7 Fig, 4 Tab, 22 Ref.

Descriptors: *Stratification, *Rivers, Seneca River, Oswego River, New York, Chemical reactions, River flow.

The occurrence and characteristics of chemically-based density stratification in portions of the Seneca and Oswego Rivers, downstream of ion-polluted Onondaga Lake, are described for seven different days in the summer and fall of 1978 and 1981, which covered a wide range of river flows. Chemically-based density stratification occurred routinely in the Seneca River downstream of the lake inflow, in response to a continuous chemically-based density difference between the two systems of 0.0015 to 0.0030 g/cu cm. The persistence of the phenomenon, and thus the longitudinal range over which the river stratification occurred, depended on the velocity of river flow and the magnitude of the density gradient that bordered the upper river water and the lower released lake water. The occurrence of chemical stratification in the river had dramatic implications on the corrresponding distribution of dissolved oxygen (DO). The isolation of the organically enriched lake water in the lower layer enhanced the depletion of DO there, which resulted in the development of substantial DO stratification downstream of the discharge from the lake during summer low flow periods. (Baker-IVI)
W84-03836

FORMATION OF PERYLENE IN RECENT SEDIMENTS: KINETIC MODELS,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2J.
W84-03863

ROLE OF EQUILIBRIUM REACTIONS IN BORE-HOLE WATERS IN THE SKELLEFTEFIELD, NORTHERN SWEDEN,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
J. Liden, and S. Sjoberg.
Nordic Hydrology, Vol. 14, No. 3, p 179-192, 1983. 5 Fig, 5 Tab, 26 Ref.

Descriptors: *Boreholes, *Water quality, *Skellefte Field, *Sweden, *Equilibrium reactions, Alkalinity, Acidity, Silicates, Iron, Sulfides, Chemical composition, Water analysis, Chemical reactions.

Measurements of pH and pe (in situ), main ionic constituents, silicic acid and aluminium were made in a series of bore holes in an acid-intermediate volcanite type rock. The bore holes covered the pH interval 6.5-8.6, each with a time invariant solution composition. Field data were used as an experimental test of computerized simulation of weathering reactions by means of equilibrium models. If the solution composition resulting from an equilibration between representative silicate minerals and pure water of P-CO2 corresponding to air is calculated, reasonable agreement is found with field data. These theoretical experiments suggest that in an undisturbed groundwater the primary silicate minerals tend to increase the pH to slightly alkaline values where the dissolved main components reach an irreversible saturation value. However, if the solution composition after an addition of protons is simulated by a stepwise decrease in pH, it is obvious that silicate minerals, including secondary clay minerals, react too slowly to control the ground water by means of any equilibrium reaction. Although a silicate mineral-water equilibrium obviously does not prevail in a system where pH has been decreased by the addition of protons, it is important to realize the strong pH-buffer that has to be crossed in order to convert for example a plagioclase to dissolved ions. As long as these primary silicates remain in the system, the pH will strive towards the alkaline side. (Baker-IVI)
W84-03986

2L. Estuaries

LIMNOLOGICAL STUDY OF SHASTA LAKE, SHASTA COUNTY, CALIFORNIA, WITH EMPHASIS ON THE EFFECTS OF THE 1977 DROUGHT,
Geological Survey, Menlo Park, CA. Water Resources Div.
S. A. Rettig, and G. C. Bortleson.
USGS Water-Resources Investigations Report 82-4081, April, 1983. 61 p, 24 Fig, 16 Tab, 15 Ref.

Descriptors: *Limnology, *Reservoirs, *Water quality, Nutrients, Biological properties, Chemical properties, Physical properties, Lake morphometry, *California, Shasta Lake, *Drought conditions, Hydrologic analysis.

An intensive limnological study of Shasta Lake was made in conjunction with the California Department of Water Resources during the 1977 drought. Water-quality data were collected from March 1977 through September 1978 at six lake stations and four lake tributary stations. Data collected during and after the drought were compared. Lake water quality is described as a function of lake morphometry, climate, hydrology, and reservoir hydraulics. Results indicate Shasta Lake is a warm monomictic lake. Tributary inflow to the lake and outflow through the dam generate density currents which promote mixing at depth and the development of an extensive metalimnion. During the drought, record low lake levels resulted in the exposure of an extensive nearshore sediment zone. Resuspended sediments caused a deterioration of water quality. The most notable effects, in comparison with post-drought conditions, were decreased light penetration, increased dissolved-solids concentration and specific conductance, decreased dissolved-oxygen concentrations, and elevated nutrient levels. A hypolimnetic anoxic condition was observed at the upstream stations of the lake. (USGS)
W84-03606

CONTRIBUTION TO THE PHYSICO-CHEMICAL LIMNOLOGY OF SWARTVLEI,
Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.
B. R. Allanson, and C. H. Williams.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 133-159, January, 1984. 15 Fig, 4 Tab, 37 Ref.

Descriptors: *Limnology, *Rivers, *South Africa, *Swartvlei, *Estuaries, Physical properties, Chemical properties, Lakes, Fulvic acid, Salinity, Meromixis, Wind.

Humate stained rivers caught up in lake basins of Pleistocene origin and connected to sinuous estuaries drain the coastal region of southern Africa in the vicinity of Knysna. The Swartvlei is the largest of these and provides an example of ectogenic

meromixis in South Africa. The lake is of low stability. Wind stress of 7.0 g cm/cm sq erodes the monimolimnion if the input of seawater is restricted by sandbars at the mouth of the estuary. The inflows of peat stained water dominate the light climate of the lake. This implies a high fulvic acid component easily degradable in the lake or estuary. While soluble reactive phosphate remains high in the anoxic monimolimnion, its transfer in significant quantities into the mixolimnion is prevented by the slow rate of erosion of the halocline during periods when the mouth of the estuary is closed. (Baker-IVI)
W84-03744

BACTERIAL PRODUCTION AND CARBON CONVERSION BASED ON SALTMARSH PLANT DEBRIS,
R. C. Newell, E. A. S. Linley, and M. I. Lucas.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 405-419, October, 1983. 3 Fig, 3 Tab, 58 Ref. NIH grant ESO-1908.

Descriptors: *Bacteria, *Carbon cycle, *Salt marshes, Plant debris, Population dynamics, Ciliates, Choanoflagellates, Amoebae, Estuaries, Sediment-water interfaces.

There is a well-defined succession of micro-organisms which colonize powdered leaf debris from Spartina alterniflora and Funcus roemerianus, and aged natural detrital material when incubated in estuarine water at temperatures near to those recorded in the habitat at the time of collection. The natural assemblage of free-living bacteria in estuarine water rapidly enters logarithmic growth, subsequently declining with the increase in numbers of bactivorous microflagelates. These are then replaced by a mixed population of ciliates, choanoflagellates, amoeboid forms and attached bacteria which form part of a complex microbial community associated with particulate debris. The rate of increase of bacterial cells (micron), in both spring and summer experiments ranged from 0.010-0.108/h while estimates of bacterial carbon production ranged from 1.5 to 10.1 microg C/l/h, values which conform well with estimates obtained from natural assemblages of marine bacteria in coastal and estuarine waters elsewhere. Although both the ease of degradation of the detrital substrate and incubation temperature are of importance, enrichment of both powdered Spartina leaf debris and aged natural detritus with inorganic nutrients evidently enhances bacterial production under experimental conditions. In addition, the amount of carbon utilized to sustain bacterial carbon production shows a significant reduction following enrichment with NH4, NO3 or combinations of NO3 + PO4. The bacterial carbon conversion efficiency (microg C incorporated into bacterial production per microg C consumed) x 100, based on powdered Spartina leaves, and aged natural detritus, is thus increased from 9-14%, to as much as 38% in nutrient enriched media. Since NH4, NO3 and PO4 values are generally low in the water column, it seems likely that bacteria achieve a carbon conversion of only 9-14% on natural suspended detrital material, with the possibility of an enhanced conversion of up to 38% occurring at the sediment-water interface where ammonia regeneration occurs. This suggests that suspended bacteria which characterize estuarine waters of salt marsh areas may be responsible for the oxidation of 86-91% of the carbon which enters water column microheterotroph food chains, and are probably implicated in the large CO2 fluxes recently recorded from coastal wetland habitats. (Murphy-IVI)
W84-03804

NUTRIENTS AND PRIMARY PRODUCTION IN PERMANENTLY WELL-MIXED TEMPERATE COASTAL WATERS,
Brest Univ. (France). Station Biologique.
M. V. M. Wafar, P. Le Corre, and J. L. Birrien.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 431-446, October, 1983. 9 Fig, 1 Tab, 35 Ref.

Descriptors: *Nutrients, *Primary production, *Meromixis, *Coastal waters, Hydrology, Seasonal cycles, France, English channel, Phytoplankton, Hydrologic regime.

Seasonal changes of nutrients and primary production were studied in Morlaix Bay (western English Channel) waters in 1979-1980. This region is characterized by strong tides and consequently the water column remains permanently well-mixed. Owing to this unique hydrological regime, primary production and nutrients follow seasonal cycles different from the classic temperate water cycles. Because of the instability of the water mass, phytoplankton development in spring is slow and attains a maximum only in summer. A minor autumnal primary production peak is absent. The slow development of phytoplankton results in a slow and prolonged utilization of nitrate and phosphate which attain their lowest values only at the end of summer. Predominance of diatoms in the spring phytoplankton results in a rapid utilization of silicon which reaches its lowest concentration as early as May. Ammonium shows a unique cycle in that it accumulates in the water column in spring-summer and is utilized by phytoplankton only when nitrate concentration is low. Nitrite changes show two peaks: a major peak in autumn associated with nitrogen remineralization and a minor peak in spring due to nitrite excretion by phytoplankton. Seasonal development of primary production in these waters is successively limited by silicon, nitrate and total inorganic nitrogen depletion in spring-summer before being eventually limited by light. This is substantiated by the seasonal changes of absolute C-14 assimilation values, solar energy utilization efficiency and assimilation number. Based on these results, it is hypothesized that the ratio between the depth of the euphotic zone and the depth of the water column will indicate whether light or nutrients limit primary productivity in well-mixed temperate waters. (Author's abstract)
W84-03805

CONSERVATIVE BEHAVIOUR OF BORON IN THE TAMAR ESTUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
M. I. Liddicoat, D. R. Turner, and M. Whitfield.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 467-472, October, 1983. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Estuaries, *Boron, *Tamar Estuary, *England, Salinity, Alkalinity.

Thirteen surveys were made of the Tamar Estuary in southwest England during 1980-1982. On each survey surface samples were taken at approximately 3 0/00 salinity intervals between Devil's Point and the point at which the surface salinity fell below 0.5 0/00 (the salt wedge station). Above this point the sampling stations were spaced at 1 km intervals and extended to Weir Head. Each of the samples surveyed showed a conservative (straight line) relationship between boron concentration and salinity. Boron concentrations above the salt-wedge station were small and generally constant. The low concentrations observed in the freshwater end-members suggests that the dissolved boron in the estuary derives almost entirely from seawater. No evidence was found for the systematic addition or removal of boron within the estuary. It is unlikely that serious errors will be introduce into the alkalinity measurements in the Tamar Estuary by calculating the contributions of boron by the sample salinity. (Baker-IVI)
W84-03806

OXYGEN CONSUMPTION BY SEDIMENTS IN A SOUTHERN AFRICAN MANGROVE SWAMP,
Transkei Univ., Umtata (South Africa). Dept. of Zoology.
A. H. Dye.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 4, p 473-478, October, 1983. 3 Fig, 1 Tab, 15 Ref.

Descriptors: *Oxygen requirements, *Sediments, *Mangroves, *Swamp, *South Africa, Mngazana estuary, Estuaries, Biological oxygen demand, Chemical oxygen demand.

Total, chemical and biological oxygen demand of intertidal sediment cores from 12 stations in a mangrove swamp in southern Africa were measured under mean temperature and salinity conditions. In addition to measuring oxygen removed from water overlying cores, the uptake of oxygen from air overlying sealed cores was also determined. Total oxygen consumption ranged from 2.9 to 37.0 ml O2/sq m/h in water and from 22.1 to 81.6 ml O2/sq m/h in air. Chemical oxygen demand usually equalled or exceeded the total, underlining problems in the measurement of this parameter. Since oxygen is not present below a few millimeters in the sediment, it is concluded that oxygen diffusing from the overlying water or air is rapidly utilized at the surface and its uptake rate does not give any measure of metabolic activity deeper down. The oxygen content of the overlying water present during high tide may drop to relatively low levels due to this demand. (Author's abstract)
W84-03807

BEHAVIOUR OF THE RARE EARTH ELEMENTS DURING MIXING OF RIVER AND SEA WATERS,
Cambridge Univ. (England). Dept. of Earth Sciences.
J. Hoyle, H. Elderfield, A. Gledhill, and M. Greaves.
Geochimica et Cosmochimica Acta, Vol. 48, No. 1, p 143-149, January, 1984. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Rare earth elements, *Rivers, *Seawater, *Mixing, *Water of Luce, *Scotland, Neodymium, Estuarine environment, Estuaries.

Rare earth element concentrations were measured in organic rich water from the Water of Luce, a river on the south-west corner of Scotland, and coastal sea water. Concentrations of about 350 to 1850 pmol/kg Nd were found in the water of the river and 45 to 350 pmol/kg Nd in Luce Bay. These concentrations were related to the presence of particles, with 30-60% of the rare earth elements (REE) associated with greater than 0.4-0.7 micrometer particles and to riverine Fe concentrations. REE fractionation occurred in the river water. The submicrometer river water was heavy with REE enrichment whereas the coarser fraction had a more shale-like REE pattern. Lab studies indicate that REE in organic-rich water are chiefly associated with Fe-organic matter colloids which flocculate during estuarine mixing. Preferential removal of heavy REE relative to light REE (95 to 60%) occurs, but no Ce anomaly is developed. In contrast, no REE removal occurs during estuarine mixing with organic-poor river water. (Baker-IVI)
W84-03865

EVALUATION OF A SEQUENTIAL EXTRACTION SCHEME TO STUDY ASSOCIATIONS OF TRACE ELEMENTS IN ESTUARINE AND OCEANIC SEDIMENTS,
Southampton Univ. (England). Dept. of Oceanography.
W. A. Maher.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 339-344, March, 1984. 2 Fig, 3 Tab, 7 Ref.

Descriptors: *Estuarine environment, *Sediments, *Trace elements, Estuaries, Sea water, Manganese, Iron, Aluminum, Organic compounds, Calcium carbonate, Carbonates, Silicon, Leaching.

Three deep sea sediments and three estuarine sediments were examined. To evaluate the optimum times for leaching the carbonate phase, sediment samples were first leached for one hour with 1 M magnesium chloride (pH 7), and then further leached with 1 M sodium acetate (pH 5), adjusted with acetic acid. The calcium concentrations were measured in the centrifuged supernatants at different time intervals. For all sediments, dissolution of calcium was complete within five hours. To evaluate the optimum time for reducing and dissolving iron and manganese oxides, sediment samples previously leached for exchangeable metals and carbonates were leached with the hydroxylamine hydrochloride-acetic acid reagent, and the iron content measured in the centrifuged supernatants at different time intervals. To assess the selectivity of each fraction, aluminium, calcium, iron, manganese

and silicon were determined in each extract. A sequential extraction scheme was found to be suitable for partitioning estuarine and oceanic sediments containing low organic carbon contents into major geochemical fractions. Due to the interaction of iron-manganese oxide phases and organic material, the selective dissolution of these fractions in organic rich sediments is not possible using the scheme outlined. (Baker-IVI)
W84-03877

PROCESS OF SEDIMENTATION ON THE SURFACE OF A SALT MARSH,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 2J.
W84-03897

NITROGEN LOSS FROM FRESHWATER AND SALINE ESTUARINE SEDIMENTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W84-03929

CHESAPEAKE BAY NUTRIENT AND PLANKTON DYNAMICS. 2. SOURCES AND SINKS OF NITRITE,
Harvard Univ., Cambridge, MA. Museum of Comparative Zoology.
J. M. McCarthy, W. Kaplan, and J. L. Nevins.
Limnology and Oceanography, Vol. 29, No. 1, p 84-98, January, 1984. 8 Fig, 3 Tab, 41 Ref.

Descriptors: *Bays, *Nutrients, *Nitrites, *Chesapeake Bay, Water pollution sources, Nitrates, Ammonia, York River, Chemical analysis, Estuaries.

A combination of N-13 tracer techniques and assays of the concentrations of chemical constituents were used to investigate the transformations of inorganic nitrogenous nutrients that can lead to the frequently observed high levels of nitrite in the Chesapeake Bay and York River. Uptake and remineralization of NH4(+) in the York River during destratification followed a diel cycle. Nitrification was not as closely coupled to the light regime. The primary source of N2O and NO2(-) appeared to be in the water rather than in the sediments. The N-15 data indicated that oxidized N could be formed in the water of the bay when physical events caused the mixing of NH4(+)-rich bottom water with more oxygenated surface layers. Also, the NO3(-) was reduced to NH4(+) at unexpectedly rapid rates in well oxygenated surface waters. The magnitude and duration of high concentrations of N2O and NO2(-) in these estuarine waters during mixing events might be expected to increase if anthropogenic loading of nutrients causes anoxic conditions in the bay to become more widespread. (Baker-IVI)
W84-03962

ABOVEGROUND AND BELOWGROUND PRIMARY PRODUCTION DYNAMICS OF TWO DELAWARE BAY TIDAL MARSHES,
Delaware Univ., Newark. Coll. of Marine Studies.
C. T. Roman, and F. C. Daiber.
Bulletin of the Torrey Botanical Club, Vol. III, No. 1, p 34-41, January-March, 1984. 3 Fig, 5 Tab, 29 Ref.

Descriptors: *Primary productivity, *Aboveground, *Belowground, *Delaware Bay, *Tidal marshes, Angiosperms, Carbon cycle, Nitrogen cycle, Canary Creek, Blackbird Creek.

Aboveground and belowground net primary productivity estimates of the dominant angiosperm from two tidal marshes along the Delaware Bay estuary including ash, carbon and nitrogen content were determined. Annual net aboveground production was determined by the peak live standing crop method and the Smalley method. Aerial production of tall Spartina alterniflora Loisel. at the Canary Creek salt marsh, employing the Smalley technique was 1487 g/sq m/yr, while production of short S. alterniflora, S. patens (Ait.) Muhl. and Distichlis spicata (L.) Greene was, 654 g/sq m/yr, 1147 g/sq m/yr, and 785 g/sq m/yr, respectively. At the brackish water Blackbird Creek marsh, Phragmites australis (Cav.) Trin. had the highest aboveground production (2940 g/sq m/yr), followed by S. patens (1089 g/sq m/yr) and short S. alterniflora (916 g/sq m/yr). Belowground primary production was determined by the annual increment (max-min) method, with respective estimates of 6.5 kg/sq/m/yr, 5.0 kg/sq m/yr, and 3.3 kg/sq m/yr, for tall S. alterniflora, short S. alterniflora and S. patens, at the Canary Creek marsh. Belowground estimates at the Blackbird Creek marsh were within this range. (Murphy-IVI)
W84-04006

TRANSPORT AND DISTRIBUTION OF NUTRIENTS IN THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA, 1979-81,
Malawi Water Resources Div., Lilongwe.
B. F. McPherson, and W. H. Sonntag.
Water Resources Bulletin, Vol. 20, No. 1, p 27-34, February, 1984. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Estuaries, *Nutrients, *Loxahatchee River Estuary, *Florida, Nitrogen, Phosphorus, Organic carbon, Mixing, Seawater, Storm runoff, Tidal flushing, Salinity, Tropical cyclones.

Concentrations of total nitrogen, total phosphorus, and total organic carbon in the Loxahatchee River estuary decreased with increasing salinity in a manner indicating that mixing and dilution of freshwater by seawater was the primary process controlling the downstream concentrations of nutrients. Most of the nutrients in the surface freshwater inflows entered the estuary from five major tributaries; however, about 10% of the total nitrogen and 32% of the total phosphorus were from urban stormwater runoff. The input of nutrients was highly seasonal and storm related. During a 61-day period of above average rainfall that included Tropical Storm Dennis, the major tributaries discharged 2.7 metric tons of total phosphorus, 75 metric tons of total nitrogen, and 1,000 metric tons of organic carbon to the estuary. This period accounted for more than half of the total nutrient load from the major tributaries during the 1981 water year (October 1, 1980, through September 30, 1981). Inorganic phosphorus and nitrogen increased relative to total phosphorus and nitrogen during storm runoff. Nutrient yield from the basin, expressed as grams per square meter of basin area, was relatively low. However, because the basin area (544 sq km) is large compared with the volume of the estuary, the basin might be expected to contribute significantly to estuarine enrichment were if not for tidal flushing. Approximately 60% of the total volume of the estuary is flushed on each tide. Because the estuary is well flushed, it probably has a large tolerance for nutrient loading. (Author's abstract)
W84-04101

PLANT GROWTH ON EXPERIMENTAL ISLAND BEDS AND NITROGEN UPTAKE FROM SURROUNDING WATER,
Papua New Guinea Univ., Port Moresby. Dept. of History.
D. E. Vasey.
Agriculture, Ecosystems and Environment, Vol. 10, No. 1, p 15-22, August, 1983. 1 Tab, 24 Ref.

Descriptors: *Nitrogen, *Island beds, *Raised beds, *Plant growth, Cultivation, Wetlands, Algae, Eutrophication.

An ancient method of preparing wetlands for cultivation consists of moving earth to form raised planting surfaces which are surrounded by water for all or part of the year. Revivials of the system are aimed at providing insights into prehistory, restoring traditional intensive methods, and adapting the system to modern agriculiural technology and commercial economies. Experimentation was begun in 1980 to determine the paths by which combined nitrogen present in the surrounding channels might become available to crops on the beds. The potential contribution of combined N from the water to crops on island beds and raised fields could be substantial, if conditions favor biological N-fixation and appropriate means of transferring organic matter and combined N are developed. Total N reached much higher levels in artificial ponds exposed to sunlight than in completely shaded ponds, and yet Para grass, planted in pots that allowed the roots to extend through to the ponds, made significantly more growth in the shaded ponds than in the sunny ponds. The test crop could not complete effectively for N with algae, and N in surrounding eutrophic bodies of water is readily available to crops on island beds only if the crop roots reach channel sediments, or organic matter is transferred form the channels to the beds. (Moore-IVI)
W84-04112

DEVELOPMENT OF BENTHIC COMMUNITIES ON NEW BREAKWATERS,
Institute of Biology of the Southern Seas, Sevastopol (USSR).
O. G. Mironov, N. Yu. Milovodova, and I. M. Tsymbal.
Hydrobiological Journal, Vol. 19, No. 1, p 49-53, 1983. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Benthic environment, *Piers, Breakwaters, Hydrobiology, Black Sea, Algae growth, Substrates, Stones.

Quantitative characteristics are presented for phyto- and zoobenthos populating newly erected pier structures. It is established that the phyto- and zoobenthos are similar in qualitative and quantitative respect to natural ones. Biocenoses of pier structures differ in a series of specific peculiarities connected with the period of their formation. The complex of animal forms populating the stones in the breakwaters which have been described is quantitatively similar to that found on the natural stones of Novorossiysk Bay, but less varied than that on the stones of the open parts of the Caucasian and Crimean coastlines. Accordingly, even during the first years of their existence, manmade stone marine structures become covered with a relatively thick biofilter resembling the natural biofilter of natural stone substrates. (Baker-IVI)
W84-04134

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

VIRUSES IN GROUNDWATER BENEATH SEWAGE IRRIGATED CROPLAND,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5B.
W84-03731

HYDROGEOLOGY FOR LAND-USE PLANNING: THE PETERS CREEK AREA, MUNICIPALITY OF ANCHORAGE, ALASAKA,
Geological Survey, Anchorage, AK. Water Resources Div.
J. O. Brunett, and M. Lee.
USGS Water-Resources Investigations Report 82-4120, 1982. 6 p, 14 Fig, 2 Tab, 23 Ref.

Descriptors: *Groundwater, *Geohydrologic units, Groundwater, Wetlands, Streamflow, Drainage, Erosion, Water quality, Water pollution, Sewage disposal, Water supply, Landslope, *Land-use planning, *Alaska, Anchorage, Peters Creek, Chugach Mountains, Knik Arm, Fire Lake, Chugiah, Birchwood, Eklutna.

Wells currently provide all water supplies in the area. Most wells obtain enough water for individual household needs from unconsolidated, principally glacial and glacioalluvial deposits. In some places, however, wells must be drilled into the underlying bedrock to obtain adequate supplies. It may be possible to develop small community supplies--for individual trailer courts or subdivisions--in areas where yields of 20 gallons per minute or greater are reported for private, domestic wells. Peters Creek is a potential source of surface-water

supply, but it would have to be treated to remove glacial silt during summer months. The chemical quality of both ground water and surface water in the area in generally acceptable for most uses. Foundation and excavation conditions, the potential for water pollution from onsite disposal of wastewater through septic tank systems, and the suitability of specific areas for certain types of development may be affected by the following factors: wetlands and areas of shallow ground water underlie about 30 percent of the study area; landslope exceeds 20 percent in about a third of the area; areas of fine-grained, low-permeability sediments are present locally; bedrock is within 25 feet of the land surface in about a third of the area. (USGS)
W84-03858

EVAPORATION REDUCTION: SUMMARY OF LONG-TERM TANK STUDIES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
K. R. Cooley.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 89-98, March, 1983. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Evaporation, *Evaporation control, Floating covers, Cost analysis, Cost-benefit analysis, Reservoir evaporation, Water conservation.

Conserving water contained in existing storage facilities, is in some situations, the most economical means of providing adequate water supplies. A review of evaporation reduction studies indicated that shades suspended above a water surface and floating covers on a water surface gave best results. Of the two, floating covers were most practical. Field tests using floating covers of foamed wax blocks, continuous wax, and foamed rubber reduced evaporation losses 36%-84% over an 8 yr period. Based on the amount of the water saved and the cost of materials used, the continuous wax covers provided the lowest cost water at $0.08 to $0.13/1,000 L/yr, followed by foamed rubber and foamed wax blocks at $0.17 and $0.18 per 1,000 L/yr, respectively. However, evaporation reduction efficiency of the continuous wax covers began to decrease after a few years of exposure, while the foamed rubber and foamed wax blocks showed no signs of deterioration. Long-term durability, efficiency, and climatic range of usability should be considered along with costs when determining the most practical cover to use. (Murphy-IVI)
W84-04039

GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 111-182, March, 1983. 14 Fig, 1 Tab, 94 Ref, 2 Append.

Descriptors: *Cloud seeding, *Weather modification, *Water resources development, Environmental effects, Social aspects, Economic aspects, Feasibility, Legal aspects, Cost-benefit analysis.

The guidelines for implementing weather modification are intended to provide water resources managers with information and references that they may need to make a decision on the use of weather modification to augment available water supplies. The sections cover a variety of aspects of weather modification including the social, legal, environmental and economic issues as well as the scientific basis. The scientific basis for cloud seeding to augment precipitation rests on the assumptions that natural cloud precipitation can be increased (static seeding) or that cloud development can be enhanced (dynamic seeding) to produce bigger clouds. The augmentation possible is fractional, in the range of 5-20%; this much additional over the farm belt would be helpful to agriculture, and the addition over mountainous terrain would benefit the hydroelectric power industry and irrigation interests. The technical details of various devices for producing artificial nuclei, and the various methods for distributing the artificial nuclei through cloud masses are described in detail. The type of generating system employed and its mode of operation depends upon the type of cloud systems that are to be treated. Initial steps toward implementing a seeding program include consideration of the need for augmented precipitation, how it would be used and alternative approaches. A feasibility study is desirable and should include a clear statement of all objectives of the proposed project. A design study should include review of objectives vs. time, statements of program goals, alternative plans, and longer term aspects. The risks and costs must be estimated as thoroughly as are the benefits. (Moore-IVI)
W84-04041

3C. Use Of Water Of Impaired Quality

REACTIONS OF HEAVY METALS AND OTHER MINERAL WATER QUALITY CONSTITUENTS WITH SOIL MATERIALS IN RAPID INFILTRATION GROUNDWATER RECHARGE SYSTEMS USING RECLAIMED WASTEWATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 4B.
W84-03697

NITROGEN AVAILABILITY FROM POTATO-PROCESSING WASTEWATER FOR GROWING CORN,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. H. Smith, and C. W. Hayden.
Journal of Environmental Quality, Vol. 13, No. 1, p 151-156, 1984. 10 Tab, 11 Ref.

Descriptors: *Nitrogen, *Potato-processing wastewater, *Corn, Sprinkler irrigation, Irrigation effects, Wastewater disposal, Water reuse, Corn yield, Wastewater irrigation, Caldwell, Idaho.

Irrigating with food-processing wastewater for growing crops is an established practice used by a large segment of the food processing industry. In many existing systems, emphasis has been placed on disposing of wastewater with maximum applications of both the wastewater and included plant nutrients. A line source sprinkler was used to irrigate corn (Zea mays L.) plots with potato (Solanum tuberosum L.)-processing wastewater in 1979, 1980, and 1981. Nitrogen applications ranged from about 4 to 600 kg/ha. Corn yields were measured for each row, the grain and stalks were analyzed for total N, and N uptake was calculated. The plots were split by years, one-third of the area was fertilized with wastewater 3 y, one-third 2 y, and one-third 1 y. This allowed evaluation of current and residual value of wastewater fertilization. Corn responded well to wastewater fertilization, with N applications in the wastewater increasing corn yields with increasing increments of N up to about 200 to 250 kg/ha annually, and corn grain yields ranged up to about 12 Mg/ha. Yield comparisons were made with plots fertilized with ammonium nitrate fertilizer. We determined that potato-processing wastewater N was almost equal to ammonium nitrate N for growing corn. Wastewater applications that will apply approximately 200 to 250 kg N/ha annually should be optimum for growing corn on this soil. Wastewater N from potato processing has good residual and carry-over for 1 y but under conditions of this experiment did not carry over for more than 1 y. Whether the excess N was lost from denitrification or leaching was not determined. (Murphy-IVI)
W84-03948

3D. Conservation In Domestic and Municipal Use

SURVEY OF STATE WATER CONSERVATION PROGRAMS IN THE U.S.,
Georgia Inst. of Tech., Atlanta. Coll. of Architecture.
For primary bibliographic entry see Field 3F.
W84-04106

3E. Conservation In Industry

RECENT ADVANCES IN TITANIUM DIOXIDE RECOVERY, FILLER RETENTION AND WHITE WATER TREATMENT,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5D.
W84-03672

3F. Conservation In Agriculture

PRICING AND CONSERVATION OF IRRIGATION WATER IN TEXAS AND NEW MEXICO,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 6B.
W84-03570

LAND CONSOLIDATION IN IRRIGATION PROJECTS,
International Bank for Reconstruction and Development, Washington, DC. East Asian and Pacific Projects Dept.
H. L. Plusquellec.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 99-110, March, 1983. 4 Fig, 2 Ref.

Descriptors: *Irrigation programs, *Rational layout, *Water distribution, *Land consolidation, Surface irrigation, Sprinkler irrigation, Irrigation efficiency, Crop yield, Farming, Developing countries.

A model for land consolidation and the layout of irrigation systems was developed in Morocco about 20 yr ago and has been used widely there ever since. Known as the 'rational layout' scheme, this approach facilitates modern farming activities and rotational water distribution in areas with diversified agriculture and small land parcels. Rational layout represents a fusion of two other approaches to irrigation layout which were tested individually with less success: (1) an agriculturist's approach emphasizing modern farming principles, particularly collective plowing; and (2) an engineering approach which provides a permanent consolidated on-farm irrigation network, including irrigation ditches, drainage channels and farm roads. The rational layout scheme is unique in dealing with the various factors that must be considered in regrouping separate small plots into consolidated areas for irrigation. These include irregular plot size, surface or sprinkler irrigation systems, crop diversification, crop rotation, and agricultural mechanization. Areas using this system have shown increased irrigation efficiency, higher yields and cropping intensity, and increased use of modern agricultural practice. (Author's abstract)
W84-04040

IRRIGATION WATER DELIVERY PERFORMANCE,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, and A. R. Dedrick.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 1-13, March, 1984. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Irrigation water, *Water delivery, *Colorado River Indian Reservation, *LaPaz county, *Arizona, Water conveyance, Water use, Flow rate, Variability.

Data were collected from sites on the Colorado River Indian Reservation, LaPaz county, Arizona, in 1980 and 1981. Twenty delivery sites within the irrigation district were monitored in order to determine the amount of variability in flow rate during each water delivery. The coefficient of variation (CV) of instantaneous (1/2 hour) flow rate values averaged for each turnout ranged from 0.04-0.29. CV was related to the location of the site within the delivery system. Time of year, flow rate, and crops grown did not appear to affect CV. On-farm water use is affected by the level of delivery flexi-

bility and the uniformity of water deliveries. Upgrading of farm irrigation systems may require improvements in delivery flexibility and uniformity. Increasing the delivery flexibility may result in less uniform deliveries, which may also reduce the operational conveyance efficiency of the delivery system unless the system is also upgraded. Delivery system performance can be improved by such structural measures as the addition of measuring devices, canal control devices, improved turnout sturctures, or reservoirs. Nonstructural (management) changes can have an equally important effect. A change of attitude is usually required by both water users and district personnel if effective improvement in system performance is to be attained. (Moore-IVI)
W84-04089

SUITABILITY OF REDUCED PRESSURE CENTER-PIVOTS,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 22-34, March, 1984. 7 Fig, 5 Tab, 14 Ref.

Descriptors: *Irrigation, *Center pivot irrigation, *Reduced pressure, *Runoff, Soil properties, Sprinkler irrigation, Irrigation depth.

Reduced pressure center-pivot systems, using spray nozzles or low-pressure impact sprinklers, are becoming popular and many existing high pressure systems are being retrofitted with reduced pressure devices. Reduced pressure systems can be operated at pivot pressures approaching 130-200 kPa, resulting in considerable energy savings. Selection criteria are developed for reduced pressure center-pivot irrigation systems. The combined effects of the application rate characteristics of center-pivot irrigation systems and the soil intake family curves were analyzed to determine the maximum depth of water which could be applied per irrigation for various types of soils and sprinkler packages. The irrigation depths are used to determine guidelines for proper selection of reduced pressure center-pivot systems. The results can be used as a general guide to determine if a particular system may have a runoff problem under a given situation. The maximum irrigation depth which may be applied without any potential runoff may be too small for some systems to provide an acceptable irrigation amount, and therefore should not be used in that particular location. (Moore-IVI)
W84-04091

STATUS OF IRRIGATION AND DRAINAGE RESEARCH IN THE UNITED STATES.
For primary bibliographic entry see Field 7A.
W84-04094

SURVEY OF STATE WATER CONSERVATION PROGRAMS IN THE U.S.,
Georgia Inst. of Tech., Atlanta. Coll. of Architecture.
T. N. Debo, and N. Rogers.
Water Resources Bulletin, Vol. 20, No. 1, p 67-74, February, 1984. 1 Fig, 1 Tab, 1 Append.

Descriptors: *Water conservation, *State jurisdiction, Legal aspects, Education, Drought.

Adequate water supplies are critical to the maintenance of a community's health and economic well-being. As the demand grows and communities actively compete with one another for a limited water supply, states are being called upon to help solve the problem. One solution being used in many areas is the development and implementation of a water conservation program. Using a mailed survey, state water conservation programs and some of the characteristics of the different programs were documented. Responses to the nationwide survey were obtained from all 50 states. The specific water conservation program elements on which information was received from the survey included laws and restricted use, community assistance, education, research, and other services. Eighteen of the 50 states indicated in the survey that they had some level of a water conservation program in operation. The need for state level programs was expressed by at least 36 states. Eighteen states indicated they have programs under development or study at the time of the survey. In addition to the states that are developing or have water conservation programs, seven states have emergency or drought water conservation programs. Seven other states have plans for emergency programs in addition to their operating programs. The 36 states which have either established a water conservation program, are developing programs, or are studying the issue should act as valuable resources for one another and the remaining states to meet the water supply needs of the future. (Moore-IVI)
W84-04106

INTRODUCING INFILTRATING IRRIGATION TECHNOLOGY.
Irrigation Journal, Vol. 33, No. 3, p 14-16, May/June, 1983. 4 Fig.

Descriptors: *Water supply development, *Irrigation, *Saline water, Infiltrating Irrigation Technology, Irrigation plans, Water supply.

An infiltrating irrigation technology (IIT) device is presented which prevents salt damage to soil. The IIT is designed to let the irrigation water abide in the soil by using the absorbing nature of soil. According to the IIT theory, the salt contained in irrigation water naturally concentrates around the emitter. Therefore, the moistened area within the soil can be automatically receiving desalted water. In tests where irrigation was performed with saline water incessantly for 11 days using IIT under a speed of 0.62 cc/min (about 990 cc/day), the IIT proved to be a simple structure capable of using water which had not been applicable as irrigation water prior to that time. (Baker-IVI)
W84-04138

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1981 - NOVEMBER 30, 1982,
Geological Survey, Trenton, NJ. Water Resources Div.
F. T. Schaefer, and R. E. Fish.
USGS Open-File Report 83-538, 1982. 91 p, 7 Fig, 19 Tab, 2 Ref.

Descriptors: *Delaware River, Diversion, Release, *Water management, Drought, *Reservoir yield, *Regulation, Supply, Inter-basin transfers, *River Master Report.

The Amended Decree of the Supreme Court of the United States in 1954 established the position of Delaware River Master to administer provisions of the decree relative to diversions from the Delaware by the City of New York and the State of New Jersey, and releases from reservoirs of the City of New York designed to maintain stipulated rates of flow in the river. Reports to the Court, not less frequently than annually, with copies to the Governors and the Mayor, were stipulated. Water-supply conditions at the beginning of the year were under a status of emergency resulting from drought, which had been declared by the Delaware River Basin Commission. With the filling of the reservoirs, the emergency was lifted April 27. Runoff of Delaware River at Montague, New Jersey, was 19 percent below median during the year as compared to 28 percent below median the previous year. By November, with reservoir storage again declining, reductions in both diversions and releases were imposed. To conserve supplies, reductions were effected on November 13 limiting New York City diversions at 680 mgd and New Jersey to 85 mgd, and the required discharge at Montague was targeted at 1,655 cfs. Water quality of the Delaware River and Estuary was monitored on a continuous basis at six sites for most of the year and on a monthly basis at ten sites to accurately locate the salt front. Highest chloride concentration observed at the Chester, PA, site was 870 mg/l November 4. (USGS)
W84-03578

FLOOD OF JUNE 15, 1981, IN GREAT BEND AND VICINITY, CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03855

TILLAGE SYSTEM AND RESIDUE COVER EFFECTS ON INFILTRATION IN NORTHWESTERN CORN BELT SOILS,
Agricultural Research Service, Morris, MN.
M. J. Lindstron, W. B. Voorhees, and C. A. Onstad.
Journal of Soil and Water Conservation, Vol. 39, No. 1, p 64-68, January-February, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Tillage, *Residue cover, *Infiltration, Rainfall-runoff relationships, Agricultural runoff, Runoff rates, Runoff volume, Soil physical properties, Hydraulic conductivity, Rainfall energy.

Some reports indicate that tillage systems leaving residue on the soil surface will reduce runoff and erosion. Other reports, however, indicate that surface residue does not always reduce runoff, particularly in no-till systems. The conflict in these reports indicates that other factors, in combination with surface residue, must influence infiltration rate and runoff potential. Simulated rainfall trials were conducted in wheel-tracked and nonwheel-tracked interrows for conventional, reduced, and no-till cropping systems immediately after planting during the first and tenth years of continuous corn. Results showed that (a) tractor wheel-traced interrows were vulnerable to runoff regardless of tillage system and (b) infiltration declined after runoff started. Runoff occurred quickly on the no-till, nonwheel-tracked interrow, indicating the presence of some infiltration restricting factor(s). Bulk density, penetrometer resistance, saturated hydraulic conductivity, and pore-size distribution were measured during the third crop year of continuous corn to determine soil physical properties that developed with tillage systems and the effect these properties had on infiltration. The no-till treatment-modified in this trial by cultivation during the previous growing season to form ridges - was characterized by a higher bulk density, greater penetrometer resistance, reduced saturated hydraulic conductivity, and a lower volume of macropores. The no-till treatment exhibited reduced infiltration. Surface crop residue effectively increased the rainfall energy required to start runoff under the reduced tillage system, but residue had no effect when soil surface conditions (no-till and wheel-tracked interrows) had developed that restricted water movement into the soil. (Murphy-IVI)
W84-03868

PRACTICAL APPLICATIONS OF A SHADING MATERIAL FOR MACROPHYTE CONTROL IN WATERCOURSES,
Freshwater Biological Association, Wareham (England). River Lab.
F. H. Dawson, and H. B. Hallows.
Aquatic Botany, Vol. 17, No. 3/4, p 301-308, December, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Rooted aquatic plants, *Aquatic weed control, *Shading, Macrophytes, Ranunculus, Nasturtium, Apium, Elodea, Sparganuim, Phragmites.

Typar, a light-weight gas-permeable opaque spunbonded polypropylene was used for the control of rooted macrophytes in flowing waters in areas

normally subject to mechanical control. The material has a relatively high tensile strength and resistance to mechanical penetration; this black-colored light-weight grade reduced the passage of light by approximately 70%. Submerged macrophytes were more rapidly controlled than emergent ones, primarily because the build up of detritus on submersed material reduced the light penetration. The period required for control varied: Ranunculus penicillatus var. calcareus, 5-8 weeks; Nasturtium officinale and Apium nodiflorum, 6-9 weeks; Elodea spp., Sparganium erectum and Phragmites australis, 12 weeks. Shorter periods give partial control whereas extended periods require macrophytes to reinvade controlled sites. This technique, i.e., the planned cycle of movement of material during the plant growing season, is considered economically competitive with other methods and could be applied to a wide variety of sites currently being managed by techniques which stress the biological system. Shaded material may be aesthetically displeasing but it does avoid excessive or rapid stress typical of mechanical control and it does not contaminate the stream system. It is local in action, reliable in effect and can give firm control of rooted macrophytes without eradicating them. Shading material may be particularly suitable for sensitive areas such as nature preserves and special interest sites and also for areas in need of constant local plant control, such as gaging weirs and in fisheries. (Moore-IVI)
W84-04118

4B. Groundwater Management

PROTECTION UNLIMITED: A PREFERRED USER'S RIGHT TO MEANS OF GROUNDWATER DIVERSION IN NEBRASKA,
For primary bibliographic entry see Field 6E.
W84-03535

ARTIFICIAL RECHARGE IN THE NORTHERN PART OF CHINO GROUND-WATER BASIN, UPPER SANTA ANA VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler.
USGS Water-Resources Investigations Report 82-4122, June, 1983. 23 p, 7 Fig, 4 Tab, 6 Ref.

Descriptors: Water resources, Hydrology, Geology, Drillers' logs, Precipitation, *Groundwater, *Artificial recharge, Infiltration rate, *California, Chino basin.

This study was made to help management design and implement a recharge-recapture system for State Water Project water in Chino Basin. Nine test holes were drilled in the study area. Analyses of data from these test holes and drillers' logs of water wells indicate the presence of clay deposits. The clay deposits cannot be correlated between holes which indicates that they are in the form of discontinuous beds or lenses. The existence and location of two ground-water barriers (Barrier 'J' and Red Hill Barrier) have been postulated in previous reports. Water-level data indicate that Barrier 'J' is probably not effectively stopping the movement of ground water. Data are insufficient to determine the effectiveness of the Red Hill barrier. Five existing recharge facilities in the study area were previously constructed to control floodflow. Infiltration tests were conducted at three of the facilities, and results of these tests indicate infiltration rates of 2.6 feet per day at Day Creek, 2.0 feet per day at East Etiwanda, and 1.3 feet per day at San Sevaine. A total of about 9,000 acre-feet of State Water Project water was recharged between June 1980 and July 1981. Rising water levels in wells indicate that recharge water is percolating down to the water table. (USGS)
W84-03584

GROUNDWATER MANAGEMENT PLANNING,
Disko (M.) Associates, Union, NJ.
M. Disko, D. Nusser, and E. Doheny.
Report, April 1978. 410 p, 66 Fig, 40 Tab.

Descriptors: *Groundwater management, *Potable water, *Permeability, *Water rights, *Groundwater inventory, Tourism, Drinking water, Domestic water, Surface-groundwater relations, Pumping tests, Legal aspects, Subsurface water, Recreation.

All of the potable water consumed in Orange County, New Jersey comes from groundwater. Increasing population and industrial development throughout the county, accompanied by the inevitable lowering of surface water quality, make the groundwater supplies all the more valuable. Industrial manufacturing and agriculture is at present of relatively minor importance in the county, while the largest influx of revenues is provided by the seasonal tourist industry, which is geared to bathers, boaters, fishermen and other sports enthusiasts. Ocean County is drained principally by east and southwest flowing consequent streams of the coastal drainage area. The streams exhibit an essentially uniform dentritic drainage pattern due to the relatively uniform nature of the underlying material. Calculations of permeability were performed for wells in the 208 Planning Area where the necessary pumping test data were available. Permeabilities ranged from 105 to 4,363 gpd/sq. ft., with an average value of approximately 1,900 gpd/sq. ft. This is somewhat higher than values determined in past studies. New Jersey law provides for the diversion of subsurface water on an allocation basis for both public and private uses. Certain wells have pump capacities less than 70 gpm, while the Lakehurst Naval Air Station and the Glidden-Durkee Company in Lakehurst divert groundwater in excess of 100,000 gpm without a permit because of 'grandfather rights'. No groundwater contamination is in the area that threatens water quality. (Garrison-Omniplan)
W84-03676

TUG HILL AQUIFER: PLANNING AND EDUCATIONAL NEEDS,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
H. B. Hughes, and K. S. Porter.
Report, 1980. 40 p, 7 Fig, 1 Tab, 2 Ref, 2 Append.

Descriptors: *Aquifer management, *Aquifer characteristics, *Stream discharge, *Projections, *Pollutants, *Education, Saturation zone, Public participation, Long-term planning, Social participation, Regional development, Chemical wastes Citizen participation.

To identify and evaluate management strategies for the use and protection of the Tug Hill Aquifer in upstate New York, specific aims were developed including technical methods for planning and management, and the preparation and dissemination of readily usable information for local residents. The proposed steps to carry out these aims include an update of land use data, construction of a water budget for the area, drilling test wells, collecting samples for baseline quality, analyzing present and future risks with contaminant budgets, measuring gain loss streamflow, analyzing water for specific contaminants of concern, producing community education products, producing maps and reports about the saturated zone and interactions with streams, and producing a manual for evaluating situations of opportunity or potential threat. These steps could be done in four phases: (1) determining catchment of wells and maximum time of contaminant travel; (2) building a mathematical model for water and contaminants near the surface; (3) diagnosing existing problems, if any; and (4) examining the implications of present and future conditions. Because of the need to allow for any uncertainties involved in doing contaminant budgets for hazardous chemicals in consumer products, a planner might suggest modification to a plan for a major development in a well catchment of a water supply well. The educational aspect of the project can be handled using public meetings, field trips, a guidebook, and microcomputers. (Garrison-Omniplan)
W84-03691

REACTIONS OF HEAVY METALS AND OTHER MINERAL WATER QUALITY CONSTITUENTS WITH SOIL MATERIALS IN RAPID INFILTRATION GROUNDWATER RECHARGE SYSTEMS USING RECLAIMED WASTEWATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. V. Mattigod, and P. F. Pratt.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154251, Price codes: A03 for paper copy, A01 for microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, November, 1983. 12 p, 7 Tab, 8 Ref, 1 Append. Project No. OWRT A-079-CAL (3).

Descriptors: *Reclaimed water, *Wastewater, *Wastewater renovation, *Groundwater recharge, *Reclaimed water, *Heavy metals, Water quality, Infiltration, Percolation, Soil chemistry, Soil properties, Superstition sand, San Emigdio soil.

Solutions containing Ca, Mg, K, Na, Pb, Ni, Cd, Cr, Cu, Zn, NH4, SO4, Cl, HCO3, PO4 at concentrations that are typically encountered in wastewaters were allowed to percolate through soil columns 15 cms in diameter and 200 cm deep in two soils; San Emigdio and Superstition sands with known physical and chemical properties were used in these experiments. The analysis of the percolating waters indicated that the trace metal concentrations were attenuated to the extent of non-detectability by atomic absorption spectrometry. The San Emigdio soil showed greater attenuation of PO4 and NH4 in comparison with Superstition sand. Speciation calculations by using GEOCHEM indicated that the major fractions of the trace metals were in cationic form and therefore would be adsorbed by the soil exchange complex. Simulations that include the presence of dissolved organics indicated that a major fraction of Cu, Ni, and Zn were complexed by the organic ligands. The speciation of Cd and Pb on the other hand were mainly influenced by the inorganic ligands. (Snyder-California)
W84-03697

MITIGATING WATER SUPPLY PROBLEMS IN THE NIGERIAN BASEMENT COMPLEX: ROLE OF UNDERSTANDING THE GEOHYDROLOGICAL ENVIRONMENT,
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W84-03770

NUMERICAL MODEL TO EVALUATE PROPOSED GROUND-WATER ALLOCATIONS IN SOUTHWEST KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
D. G. Jorgensen, H. F. Grubb, C. H. Baker, Jr., G. E. Hilmes, and E. D. Jenkins.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $5.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4095, 1982. 46 p, 14 Fig, 1 Tab, 8 Ref.

Descriptors: *Groundwater management, Computer model, *Water rights, *Kansas, Water allocation, Interactive programs.

A computer model was developed to assist the Southwest Kansas Groundwater Management District No. 3 in the evaluation of applications to appropriate ground water. The model calculated the drawdown due from a proposed well at all existing wells in the section of the proposed well and at all wells in the adjacent eight sections. The depletion expected in the 9-square-mile area due to all existing wells and the proposed well is computed and compared with allowable limits defined by the management district. An optional program permits the evaluation of allowable depletion for one or more townships. All options are designed to run interactively, thus allowing for immediate evaluation of proposed ground-water withdrawals. (USGS)
W84-03850

4C. Effects On Water Of Man's Non-Water Activities

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE SNIDER CREEK AREA, ROSEBUD AND ASHLAND COAL FIELDS, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
M. R. Cannon.
Available from the Ofss, USGS, Box 25425, Fed. Ctr. Denver, CO 80225; Price: $4.00 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 82-4051, February, 1983. 28 p, 3 Tab, 23 Ref.

Descriptors: *Coal mines, Hydrology, Groundwater, Wells, Data collection, Rosebud coal field, *Montana, *Mining impacts, Snider Creek, Ashland coal field.

The Snider Creek area of the Rosebud and Ashland coal fields contains strippable reserves of Federal coal that have been identified for potential lease sale. A hydrologic study has been conducted in the potential lease area to describe the existing hydrologic systems and to assess potential impacts of surface coal mining on local water resources. Hydrogeologic data collected from stock wells, observation wells, and drill holes indicate that shallow aquifers exist within the Tullock, Lebo Shale, and tongue River Members of the Fort Union Formation (Paleocene age) and within valley alluvium (Pleistocene and Holocene age). Most of the wells in the area are completed in the basal part of the Tongue River Member or in the upper part of the Lebo Shale Member and are used for watering of livestock. Small stock reservoirs are the primary source of surface water; Snider Creek and all other streams that originate in the area are ephemeral. The Terrett coal bed, the primary coal bed of the area, is located above the water table. Mining of the Terrett coal bed would destroy one stock well and several small reservoirs. Four other wells near the coal outcrop might be destroyed by mining. Alternative ground-water supplies are available to replace those lost by mining. Degradation of the quality of ground water, caused by the leaching of soluble salts from mine spoils, is not anticipated. (USGS)
W84-03562

WATER LEVELS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-1979,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03563

MAN-INDUCED CHANNEL ADJUSTMENT IN TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
C. H. Robbins, and A. Simon.
USGS Water-Resources Investigations Report 82-4098, 1983. 129 p, 71 Fig, 5 Tab, 38 Ref.

Descriptors: *Aggradation, *Alluvial rivers, *Degradation, *Specific gage, *Tennessee, Erosion, Stages, Flood plains, Bridges, Hydraulic design, Shear stress, Mathematical equations, Streams, Streambeds, Fluvial morphology, Slope adjustment, Knickpoint migration, Bed level lowering, *Channelization.

Channel modifications in Tennessee, particularly in the western part, have led to large-scale instabil ities in the channelized rivers and may have contributed to several bridge failures. These modifications, together with land-use practices, led to downcutting, headward erosion, downstream aggradation, accelerated scour, and bank instabilities. Changes in gradient by channel straightening caused more severe channel response than did dredging or clearing. Large-scale changes continue to occur in all the channelized rivers: the Obion River, its forks, and the South Fork Forked Deer River. However, the non-channelized Hatchie River in west Tennessee not only withstood the natural stresses imposed by the wet years of 1973 to 1975 but continues to exhibit characteristics of stability. Water-surface slope, the primary dependent variable, proved to be a sensitive and descriptive parameter useful in determining channel adjustment. Adjustments to man-induced increases in channel-slope are described by inverse exponential functions of the basic form $S=ae(-b(t))$; where 'S' is some function describing channel-slope, 't' is the number of years since completion of channel work, and 'a' and 'b' are coefficients. Response times for the attainment of 'equilibrium' channel slopes are a function of the magnitude and extent of the imposed modifications. The adjusted profile gradients attained by the streams following channelization are similar to the predisturbed profile gradients, where no alteration to channel length was made. Where the channels were straightened by constructing cut-offs, thus shortening channel length, then slope adjustments (reduction) proceed past the predisturbed profile gradients, to new profiles with lower gradients. (USGS)
W84-03567

EFFECTS OF URBAN DEVELOPMENT ON THE AQUIFERS OF THE MEMPHIS AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
D. D. Graham.
USGS Water-Resources Investigations Report 82-4024, 1982. 20 p, 6 Fig, 3 Tab, 21 Ref.

Descriptors: *Tennessee, *Water supply, *Groundwater, *Aquifers, Land subsidence, Groundwater pollution, Landfills, Waste disposal, Groundwater movement, Potentiometric level, Memphis area, Withdrawal.

Ground-water withdrawals from aquifers in the Memphis area average about 190 Mgal/d. Potential problems associated with increases in pumpage and urban development are lowered water levels, contamination of the aquifers, and land subsidence. Long-term water-level declines in the Memphis Sand, the principal artesian aquifer of the area, range from less than 0.1 ft per year near the outcrop area to about 1.8 ft per year near the center of pumping. A 1980 map of the potentiometric map surface shows that small cones of depression around major pumping centers are superimposed on a regional cone. Except for increased pumping lift, few problems are expected from water level declines in the Memphis Sand. At present, there is very little pumpage from other aquifers in the area--the alluvium, the fluvial deposits and the Fort Pillow Sand--and no long-term water level declines are expected unless pumpage is increased significantly. Low concentrations of leachates from waste-disposal sites in the area have been detected in the water table aquifers near these sites, but no indication of contamination of the underlying artesian aquifers has yet been found. Seasonal land-surface elevation changes of less than 0.03 ft have been recorded by an extensometer near the center of the major cone of depression of the Memphis Sand. These changes correlate with seasonal changes in artesian pressure in the Memphis Sand. Over the period of record no significant net change in land-surface elevation has been recorded. (USGS)
W84-03586

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE ROCK ISLAND AREA, LE FLORE COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03595

MAGNITUDE AND FREQUENCY OF FLOODS IN NEW JERSEY WITH EFFECTS OF URBANIZATION,
For primary bibliographic entry see Field 2E.
W84-03684

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE GREENLEAF-MILLER AREA, ASHLAND, COAL FIELD, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $4.50 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4101, Feb. 1983. 31 p, 5 Fig, 5 Tab, 25 Ref.

Descriptors: Hydrology, Strip mines, *Water supply, *Groundwater, Powder River Basin, Ashland coal field, *Montana.

The Greenleaf-Miller area of the Ashland coal field contains reserves of Federal coal that have been identified for potential lease sale. A hydrologic study was conducted in the potential lease area in 1981 to describe the existing hydrologic system and to assess potential impacts of surface coal mining on local water resources. The hydrologic data collected from wells, test holes, and springs were used to identify aquifers in the alluvium (Pleistocene and Holocene age) and the Tongue River member of the Fort Union Formation (Paleocene age). Coal, clinker, and sandstone beds comprise the aquifers in the Tongue River Member. Most streams are ephemeral and flow only as a result of precipitation. The only perennial surface-water flow in the study area is along short reaches downstream from springs. A mine plan for the area is not available; thus, the location of mine cuts, direction and rate of the mine expansion, and duration of mining are unknown. The mining of the Sawyer and Knoblock coal beds in the Tonge River Member would effect ground-water flow in the area. Declines in the potentiometric surface would be caused by dewatering where the mine pits intersect the water table. Wells and springs would be removed in the mine area; however, deeper aquifers are available as replacement sources of water. The chemical quality of the ground water would change after moving through the spoils. The change would be an increase in the concentration of dissolved solids. (USGS)
W84-03853

EFFECTS OF AGRICULTURAL DRAINAGE ON UPLAND STREAMFLOW: CASE STUDIES IN MID-WALES,
Institute of Hydrology, Wallingford (England).
M. D. Newson, and M. Robinson.
Journal of Environmental Management, Vol. 17, No. 4, p 333-348, December, 1983. 7 Fig, 3 Tab, 18 Ref.

Descriptors: *Drainage, *Streamflow, *Land management, *Wales, Runoff, Flood control, Floods, Watercourses, Agricultural runoff, Agricultural hydrology.

Two small sites in mid-Wales were instrumented to investigate claims that the drainage of upland areas for agriculture can lead to an increased flood risk for areas downstream. Measurements at both sites indicated that the effect of the artificial drainage was to reduce the peak rates of outflow into the stream network. This reduction was achieved by a general lowering of the soil water table, providing both an increase in the available moisture storage at times of rainfall and encouraging the movement of water in deeper, less permeable, horizons of the soil. The incidence of waterlogging of surface layers was approximately cut in half, preventing poaching (structural damage of the soil through compaction by stock). While it seems that drainage of farmland would tend to moderate the flood risk downstream, caution must be used in extrapolating these results to specific situations. For example, delaying runoff from areas whose peak flows normally occurred before the catchment peak would tend to build up the overall peak discharge. Farm drainage schemes often require prior improvement of the main watercourses to provide sufficient freeboard for the drain outfalls to discharge freely. Such channel works tend to increase flow velocities and peak discharges and so will tend to counter the effect of slower runoff into the channel

network. This factor may be expected to become increasingly important as larger catchments are considered. (Baker-IVI)
W84-03955

EFFECTS OF CLEARCUTTING AND SITE PREPARATION ON STORMFLOW VOLUMES OF STREAMS IN PINUS ELLIOTTII FLATWOODS FORESTS,
Southeastern Forest Experiment Station, Gainesville, FL.
B. F. Swindel, C. J. Lassiter, and H. Riekerk.
Forest Ecology and Management, Vol. 5, No. 4, p 245-253, April, 1983. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Storm runoff, *Forest management, *Clearcutting, *Pines, *Florida, Cutting management, Logging, Streamflow, Flood peak, Runoff, Windrowing.

Operational-sized watersheds in pine flatwoods of the Lower Coastal Plain in north Florida were isolated and continuously monitored for 3 1/2 years. Recording flumes assessed quantity of runoff water. After 1 year of calibration monitoring, two of the three watersheds were harvested, site-prepared, and planted under distinct harvest and regeneration practices. Minimum practices, imposed on one watershed, consisted of manual shortwood harvest of pinelands, roller drum chopping of harvest residues and residual understory, bedding, and planting. Maximum practices, imposed on another, consisted of tree-length logging of pinelands with heavy equipment, extraction of lightwood stumps, burning and windrowing of logging residue and residual understory, harrowing, bedding, and planting. Both silvicultural systems increased stormflow volumes; but the maximum practices increased stormflow volumes more. Stormflow volumes apparently increased immediately following tree harvests. The increase persisted through site preparation, planting, and subsequently for 1 1/2 years without further detectable change. Based on this and two previous studies on the hydrologic response of flatwoods forests to silviculture, some conclusions were drawn. Peakflow rate is considered to be a sensitive parameter that may be detectably altered by silviculture, including clearcutting. Windrowing appears to be the most influential practice in increasing peakflow rates. Total surface water yield response is quite distinct depending on the silvicultural system employed. Practices that denude and level the soil surface and stream banks may produce a persistent increase in water yield. (Moore-IVI)
W84-04125

PRESCRIBED BURNING OF PINUS OOCARPA IN HONDURAS; I. EFFECTS ON SURFACE RUNOFF AND SEDIMENT LOSS,
Escuela Nacional de Ciencias Forestals, Comayagua (Honduras).
J. Hudson, M. Kellman, K. Sanmugadas, and C. Alvarado.
Forest Ecology and Management, Vol. 5, No. 4, p 269-281, April, 1983. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Prescribed burning, *Runoff, *Soil erosion, *Pines, *Honduras, Slope, Vegetation, Grasses, Forbs.

The effects of low-intensity prescribed burning on surface runoff and sediment loss were studied in a stand of oocarpa pine (Pine oocarpa Schiefe) in central Honduras. The effects of burning in two seasons were compared on small paired plots on 10 degree, 25 degree and 40 degree slopes. Over a period of almost 2 years, mean percent runoff was 1.73% on the control plots and 5.03% on the burned plots. Mean sediment loss during the same period was 80 kg/ha on the control plots and 1732 kg/ha on the burned plots. The relationship between slope and surface runoff and sediment loss was negative; the effect of slope being masked by variation of other site factors. Recovery from burning was rapid and is attributed to the rapid rate of recovery of the ground vegetation of grasses and forbs which are adapted to frequent burning. Surface runoff and sediment loss on control plots were very low and the increases caused by burning are considered an acceptable alternative to the exposure of the overstory and site to the high risk of wildfires in accumulated fuels. Greater runoff and sediment loss were recorded on the plots buring in February than on those burned in June. As the period November to mid-February offers the greatest number of days with weather conditions suitable for low-intensity prescribed burning, it is concluded that burning for hazard reduction should be conducted as early as possible in this period, in November and December, to permit greater recovery of the ground vegetation before the heavy rains of May and early June. (Author's abstract)
W84-04126

REDUCED-RANK PREDICTION MODEL OF STREAM-CHANNEL SIZE RESPONSE TO TRADITIONAL AGRICULTURAL LAND-USE PRACTICES IN SOUTHWESTERN NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Geography.
F. O. Odemerho.
Journal of Hydrology, Vol. 70, No. 1-4, p 85-100, 1984. 9 Tab, 28 Ref.

Descriptors: *Land use, *Channel morphology, *Channel size, *Nigeria, Channel erosion, Fallowing, Farming, Overland flow, Environmental effects.

Stream-channel morphologic responses are found to be related to different parameters measuring traditional agricultural land-use patterns and practices in 50 small headwater basins in southwest Nigeria. The problem of intercorrelations among these parameters made it initially difficult to establish their precise channel enlargement effects and to calibrate an impact prediction model. Through factor analysis of the 22 land-use and morphometric parameters, six factors identified as measures of traditional land-use practice, farm size, planting activities, shortened fallow, relief and overland flow, were found to account for 86% of the variance in the data. The factor-defining variables are length of cropping period, areas in short fallow, farm-plot size, length of farm preparation relief ratio and overland flow. In a multiple regression analysis, only the first three variables were found to be statistically significant in explaining stream-channel morphologic responses. Thus, areas in short fallows, average farm size and length of cropping period adequately described those aspects of the traditional farming practices that effect basin hydrologic and channel responses. Since these variables were orthogonally derived, they formed the basis for the evaluation of the channel impact status of traditional land-use activities. The duplication of information and effects in the original 22-variable full-rank model were removed while utilizing the three-factor reduced model. (Author's abstract)
W84-04144

4D. Watershed Protection

STRAW RESIDUE TO CONTROL FURROW EROSION ON SLOPING, IRRIGATED CROPLAND,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
R. D. Berg.
Journal of Soil and Water Conservation, Vol. 39, No. 1, p 58-60, January-February, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Erosion control, *Farm management, *Straw, *Idaho, *Irrigation, Crop yield, Sedimentation, Silt, Soil conservation.

Many fields in southern Idaho have a relatively flat slope at the upper end and a steep slope toward the middle or lower end of the field. During irrigation, flow velocity increases on the steeper sloping sections of furrows, and soil erosion increases greatly. Small amounts of straw placed uniformly in steeply sloping portions of irrigation furrows reduced soil erosion and sedimentation on three fields with an erodible silt loam soil. Erosion was eliminated during the first irrigation on two fields in the straw-treated plots and markedly reduced during subsequent irrigations on these plots and on the third field. The reduction ranged from 30 to 100% in straw-treated furrows compared to furrows without straw. Straw treatment also increased infiltration and lateral water movement significantly, and crop yields rose 7 to 16%. Placing straw in the furrows below the critical-slope areas resulted in the trapping of too much sediment. Furrows filled with sediment, resulting in inadequate irrigation of downslope portions of the field. (Baker-IVI)
W84-03867

SEDIMENTATION PROBLEMS IN RIVER BASINS,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
For primary bibliographic entry see Field 2J.
W84-03970

WATERSHED RESPONSES TO CONSERVATION MEASURES,
Central Soil and Water Conservation Research and Training Inst., Dehra Dun (India).
G. Sastry, and V. V. D. Narayana.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 14-21, March, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Water conservation, *Watershed management, *Doon Valley, *India, Forest watersheds, Agricultural watersheds, Runoff, Soil conservation, Check dams, Soil loss, Land use, Grazing.

In Doon Valley, India, when a natural forest watershed open to grazing is deforested and cultivated, volume and peak rates of runoff were higher by 15% and 72%, respectively. When the agricultural watershed is treated with soil and water conservation measures (construction of small field levees or bunds), the peak rate and volume of runoff are reduced by 86% and 62%, respectively, of the corresponding values when it was a natural forest watershed and the corresponding reduction in soil loss was 94%. When another comparable natural forest watershed is provided with brushwood check dams at appropriate locations, although no appreciable reduction in peak rate of runoff was observed, soil loss was reduced by 54%. (Author's abstract)
W84-04090

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

WATER POLLUTION: A VIEW FROM ECOLOGY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
G. Sabatini, and B. M. Marcotte.
Marine Pollution Bulletin, Vol. 14, No. 7, p 254-256, 1983. 1 Tab, 15 Ref.

Descriptors: *Bioassay, *Water pollution effects, Industrial wastes, Environmental effects, Pollutant identification, Trout, Diatoms, Marine bacteria.

The results of various methods typically used by governments to assess the environmental impact of potential pollutants do not give comparable results. It is argued that the cause is not the assessment techniques themselves, but rather the paradigm of ecology from which they spring. Three bioassays are examined: LC-50, EC-50, and CI-50. The potentially toxic pollutant tested with the three bioassays was a heavy metal effluent from a plating industry containing 1.5 ppm Cr and 26.3 ppm Ni. Bioassay species used included the trout Salmo gairdnerii, the marine diatom Thalassiosira pseudonana and the marine bacterium Photobacterium phosphoreum. Three entirely different results were obtained with the three different techniques used. (Baker-IVI)
W84-03537

ENUMERATION OF THE BACTERIAL CONTAMINATION OF BIVALVES IN MONITORING THE MARINE BACTERIAL POLLUTION,
Brest Univ., Quimper (France). Inst. Univ. de Technologie.
A. Plusquellec, M. Beucher, and Y. Legal.
Marine Pollution Bulletin, Vol. 14, No. 7, p 260-263, 1983. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Enumeration, *Bacteria, *Contamination, *Bivalves, *Marine pollution, Shellfish, Coliforms, Streptococci, Water pollution, Detection limits, Bacterial analysis, Bioindicators, Fate of pollutants.

Marine organisms such as shellfish are capable of filtering large amounts of sea water and of retaining pathogenic bacteria. This property constitutes a way for evaluating the level of bacteria contamination in sea water. The enumeration of bacterial contamination was based on current fecal indicators. The sensitivity of mussels to concentrate bacteria is important and can be useful for detecting low levels of contamination which would otherwise be poorly evaluated by a direct analysis of water. The concentration factor appears to be more important for streptococci than for coliforms. This result could be the consequence of a differential absorption or a selective trapping of the two kinds of bacteria by the bivalves according to the dimensions of the microorganisms. The comparison between the level of bacteria in mussels and in the surrounding water shows that the contamination of mussels partially reflects that of the water at the same time. Different results would perhaps have been found if the analysis had been based on shellfish meat after the intervalvar water had been withdrawn. Despite some limitations, the use of shellfish as concentrating material appears to improve the bacterial enumeration results both in accuracy and consistency. (Murphy-IVI)
W84-03539

PREDICTING THE BIOACCUMULATION OF ORGANIC COMPOUNDS IN MARINE ORGANISMS USING OCTANOL/WATER PARTITION COEFFICIENTS,
Southern California Coastal Water Research Project Authority, Long Beach.
R. W. Gossett, D. A. Brown, and D. R. Young.
Marine Pollution Bulletin, Vol. 14, No. 10, p 387-392, 1983. 3 Tab, 22 Ref. NOAA grant NA80RAD00040.

Descriptors: *Prediction, *Bioaccumulation, *Organic compounds, *Octanol/water partition coefficients, Sediments, Aquatic fauna, Wastewater disposal, Wastewater management, Wastewater composition.

With the establishment of EPA's Priority Pollutant list, a growing number of wastewaters are now being analyzed for approximately 120 organic compounds. With the increasing number of organic compounds being discharged and the relatively high cost of analysis, it seems prudent to devise a means of assigning priorities as to which of these compounds should be routinely mentioned. One such approach is the utilization of the organic solubility of a compound as a predictive tool for its bioaccumulation by exposed organisms (n-octanol/water partition coefficient). Sediments and animals collected from near the discharge zone of the Los Angeles County wastewater treatment plant were analyzed for 27 selected organic compounds that had been identified in the effluent. The sediment and tissue concentrations of these organic compounds were positively correlated with each other and with the n-octanol/water partition coefficient but these were negatively correlated with the effluent concentration. The n-octanol/water partition coefficients should be used to predict which organics have the potential to bioaccumulate and therefore cause biological effects. (Murphy-IVI)
W84-03541

DETERMINATION OF DISSOLVED ALUMINUM IN WATER SAMPLES,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Afifi.
USGS Water-Resources Investigations Report 82-4018, 1983. 13 p, 5 Fig, 2 Tab.

Descriptors: Chelation, Spectrophotometric analysis, Dissolved aluminum, Moneric aluminum, Adsorption, *Pollutant identification, Methyl isobutyl ketone extract, Standard addition technique, *Aluminum, *Water analysis.

A technique has been modified for determination of a wide range of concentrations of dissolved aluminum (Al) in water and has been tested. In this technique, aluminum is complexed with 8-hydroxyquinoline at pH 8.3 to minimize interferences, then extracted with methyl isobutyl ketone (MIBK). The extract is analyzed colorimetrically at 395 nm. This technique is used to analyze two forms of monomeric Al, nonlabile (organic complexes) and labile (free, Al, Al sulfate, fluoride and hydroxide complexes). A detection limit 2 ug/L is possible with 25-ml samples and 10-ml extracts. The detection limit can be decreased by increasing the volume of the sample and (or) decreasing the volume of the methyl isobutyl ketone extract. The analytical uncertainty of this method is approximately + or - 5 percent. The standard addition technique provides a recovery test for this technique and ensures precision in samples of low Al concentrations. The average percentage recovery of the added Al plus the amount originally present was 99 percent. Data obtained from analyses of filtered standard solutions indicated that Al is adsorbed on various types of filters. However, the relationship between Al concentrations and adsorption remains linear. A test on standard solutions also indicated that Al is not adsorbed on nitric acid-washed polyethylene and polypropylene bottle wells. (USGS)
W84-03587

ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL IN SELECTED RIVERS AND ESTUARIES IN WESTERN OREGON AND WASHINGTON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03601

USE OF A MIXED ALGAL CULTURE TO CHARACTERIZE INDUSTRIAL WASTEWATERS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
A. Claesson.
Ecotoxicology and Environmental Safety, Vol. 8, No. 1, p 80-96, February, 1984. 9 Fig, 4 Tab, 12 Ref.

Descriptors: *Algae, *Industrial wastewater, Polyvinylchloride, Textile mill wastes, Chemical wastes, Mine wastes, Pulp wastes, Oil wastes, Algal growth, Bioindicator, Water pollution effects.

There is a great need for the capability to predict the effects of complex wastewater effluents from industrial processes on the natural environment. To be able to increase the value of the predictions, specifically for the recipient, it is necessary to study the influence of an effluent on the living organisms. A mixture of five freshwater algae was cultivated with additions of wastewater samples from chemical, mining, polyvinylchloride, textile, paper mill, and oil refinery industries. Two water samples from chemical industries and one from an oil refinery stimulated the algal growth in a nutrient-poor medium, while growth in other samples, including a nutrient-rich medium, was inhibited in several different ways. For eight of the water samples a delayed growth of 2-4 days was noted. Decreased growth rate and lowered maximal biomass occurred in seven of the samples. The photosynthetic capacity of the algal cells was measured by using in vivo fluorescence of chlorophyll a. These quick measurements mostly agreed with those of the growth rates. When the species composition of the mixed algal culture was investigated, large differences in sensitivities between the different species were found. Stimulation or inhibition were observed in the same sample for different species but also for the same species at different concentrations. To use a mixed algal culture is one attempt to increase the value of prognosis for the fate of substances, products, or industrial wastewaters when discharged into recipients. By exposing algae to constant concentrations of a test sample (flow-through experiments), and by keeping the environmental conditions as equal as possible to the actual effluent situation, more accurate predictions for the recipient situation should be possible. (Murphy-IVI)
W84-03705

RAPID-CELL CULTURE ASSAY OF WATER QUALITY,
Oklahoma State Univ., Stillwater. School of Biological Sciences.
S. R. VanDoren, M. S. Hall, L. B. Frazier, and F. R. Leach.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 220-226, February, 1984. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Cultures, *Water quality, *Bioassay, HeLa cells, Monitoring, Toxicity, Thymidine, Pollutants.

A cell culture screen was developed to determine water quality of environmental samples. The assay uses HeLa cells growing on microcarrier beads and a 4 hr thymidine incorporation as a screen for water toxicity. Advantages of the system are: the use of a small volume of water in the test; the ability to do the test and have the final result within a 24 hr period; the use of a large number of cells which eliminates the complications produced by using a few organisms in a bioassay; and the capability of using other biosysnthetic processes to assess toxicity. The use of the assay is demonstrated with two types of environmental samples, one a typical oil refinery effluent and the other a sample of water from the Tar Creek area of Oklahoma which serves as the principal drainage system of the Picher field, one of the most productive lead-zinc mining districts in the United States. (Baker-IVI)
W84-03708

USE OF FISH GILL AND LIVER TISSUE TO MONITOR ZINC POLLUTION,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
J. G. Saltes, and G. C. Bailey.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 233-237, February, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Zinc, *Trout, *Water quality, *Monitoring, Spokane River, Washington, Biological magnification, Fish.

Zinc bioconcentration in 13 rainbow trout and 5 brook trout was determined to understand whether zinc concentrations in gill and liver tissue of the wild salmonids had decreased with the decline in ambient concentrations. The mean and range of zinc concentration in gill and liver tissues of the 1980-81 fish was 1000 (382-1634) and 395 (155-749) micrograms/g, respectively. The mean bioconcentration factors were 9708X for gill and 3835X for liver tissue. It was expected that the zinc concentration of liver tissue of Spokane River fish would reflect the lower ambient concentrations. The fact that this did not occur suggests that there are other unknown factors which account for this discrepancy in tissue concentrations of zinc and zinc exposure for the Spokane River fish. The use of fish tissue as an indicator of metal concentration in an aquatic system may not be appropriate for a metal such as zinc which is homeostatically controlled. Investigators are urged to refrain from using fish as biomonitors of metal pollution until fish response to metal stress can be properly interpreted. (Baker-IVI)
W84-03710

IRON AND HYDROGEN SULFIDE INTERFERENCE IN THE ANALYSIS OF SOLUBLE

REACTIVE PHOSPHORUS IN ANOXIC WATERS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
G. Nurnberg.
Water Research, Vol. 18, No. 3, p 369-377, 1984. 9 Fig, 4 Tab, 40 Ref.

Descriptors: *Water analysis, *Phosphorus, Hydrogen sulfide, Water quality control, Hypolimnion, Chemical analysis, Anoxic water, Iron, Calcium.

Anoxic water from eight lakes containing various amounts of ferrous iron, hydrogen sulfide, calcium and total phosphorus was analyzed for soluble reactive phosphorus (SRP). Hydrogen sulfide concentrations higher than 1 mg/l and ferrous iron concentration above 0.20 mg/l produced interferences in the SRP analysis on many occasions. Interfering concentrations of these materials are present in anoxic water from a large number of lakes, groundwater springs and ocean basins. Ferrous iron is not problematic to the analysis if the sample is kept anoxic before and during filtration. Vigorous aeration is obligatory if hydrogen sulfide is present. For water from the anoxic hypolimnia of the eight lakes a modified analysis of total (unfiltered) reactive phosphorus (TRP) yields on average only 2% lower phosphorus concentrations than SRP analysis. TRP hence can replace the complicated SRP in anoxic water analysis. (Baker-IVI)
W84-03740

GROWTH RESPONSE IN FISH CHRONIC AND EARLY LIFE STAGE TOXICITY TESTS: A CRITICAL REVIEW,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
D. M. Woltering.
Aquatic Toxicology, Vol. 5, No. 1, p 1-21, February, 1984. 1 Fig, 4 Tab, 120 Ref.

Descriptors: *Toxicity, *Testing procedures, *Water pollution effects, *Fish, Metals, Pesticides, Organic compounds, Detergents, Inorganic compounds, Effluents, Growth stages.

The utility of the standard fish chronic toxicity endpoints to chemical hazards evaluations was examined through analysis of toxicity data from 25 years of fish life cycle chronic, partial chronic and early life stage tests. Particular emphasis was placed on the growth response. The 173 tests evaluated included exposure to metals, pesticides, unclassified organics, inorganic compounds, detergents and complex effluents. Survival of fry was significantly reduced in 57% of all tests at the lowest effect concentration. Growth of fry was reduced in 36% and egg hatching in 19% of tests. Fry survival and growth were very often correlated as equally sensitive, but fry growth was the single most sensitive response in only 14% of the tests. As presently used, the growth response could be deleted from routine applications of the fish early life stage test. The net result would be a significant reduction in the duration and cost of screening tests with no appreciable impact on estimating the maximum acceptable toxicant concentration (MATC) for chemical hazard assessments. Whether or not to include growth (or reproduction) as a routine endpoint in fish chronic toxicity tests is ultimately a question of what additional sensitivity or information is gained or could be with some modification, and how the time and money should be spent to screen new and expanded-use chemicals and effluents. The available data base suggests that the additional time and expense of the standard growth response in fish early life stage tests are unwarranted for routine chemical hazard assessments. (Baker-IVI)
W84-03741

BEHAVIOURAL BIOASSAY FOR IMPAIRED SEA-WATER QUALITY USING THE PLANTIGRADES OF THE COMMON MUSSEL MYTILUS EDULUS L.: THE RESPONSE TO COPPER,
Sheffield Univ. (England). Dept. of Zoology.
N. M. H. Sheffrin, N. R. J. Fieller, and E. E. Williams.
Aquatic Toxicology, Vol. 5, No. 1, p 77-91, 1984. 6 Fig, 5 Tab, 37 Ref.

Descriptors: *Bioassay, *Copper, *Mussels, *Behavior, Effects of pollutants, Plantigrades, Mytilus, Seawater.

A bioassay is presented which is based upon the ecologically significant behavioral responses of crawling and byssal attachment of the plantigrades of the common mussel for copper-impaired sea water. Potentiometric stripping analysis has been used to quantify the total and electrochemically labile species of copper. The threshold of sensitivity for the bioresponse lies between 13 ppb total, 8 ppb labile and 25 ppb total, 15 ppb labile copper, for a bioassay of 1 hr duration. There is an example of hormesis for the bioresponse of the number of plantigrades that crawl for levels of copper at and below 13 ppb total, 8 ppb labile metal. The effects of light and gravity as directional cues and the effect of animal size and density in the bioassay have also been considered. The test organism is available for most of the year and is economically and ecologically important. Individuals are of similar age/size and from the same area. The bioassay is easy to learn, cheap to run, short in duration and meets the normal statistical requirements. (Baker-IVI)
W84-03743

AUSTRALIAN FRESHWATER MUSSEL VELESUNIO AMBIGUUS (PHILIPPI) AS A BIOLOGICAL MONITOR FOR ZINC, IRON AND MANGANESE,
Adelaide Univ. (Australia). Dept. of Zoology.
P. J. Millington, and K. F. Walker.
Australian Journal of Marine and Freshwater Research, Vol. 34, No. 6, p 873-892, 1983. 10 Fig, 7 Tab, 38 Ref.

Descriptors: *Pollutant identification, *Bioindicators, *Mussels, Zinc, Iron, Manganese, Heavy metals, Velesunio, Australia, River Murray.

The possible use of the hybrid mussel V. ambiguus as a biological monitor of zinc was explored in the River Murray. A high variation in zinc content was found among individuals and between populations. Part of the variation was systematic, associated with body weight and age. However, a larger part remained statistically unexplained. Further, while V. ambiguus readily accumulated zinc, depuration was slow. At zinc concentrations of 210 mg/l and above, mussels avoided taking up zinc by significantly curtailing siphoning, movement and valve opening. At zinc levels above 20 mg/l, lethal level, most deaths occurred in the post-exposure periods immediately after 96-, 176- and 336-hr toxicity tests. The estimated 336 hr LC50 was 66 mg/l with 95% confidence limits 55 and 77 mg/l. Exposure of caged mussels in the zinc-contaminated Molonglo River, New South Wales suggests that V. ambiguus is not suitable as a species to monitor variations in zinc loads between sites, and does not accurately reflect environmental fluctuations of zinc, iron, or manganese, although it may have potential for materials other than heavy metals. (Baker-IVI)
W84-03750

MOLECULAR PHOTOLUMINESCENCE SPECTROMETRY WITH HYDRIDE GENERATION FOR DETERMINATION OF TRACE AMOUNTS OF ANTIMONY AND ARSENIC,
National Research Inst. for Pollution and Resources, Kawaguchi (Japan).
H. Tao, A. Miyazaki, K. Bansho, and Y. Umezaki.
Analytical Chemistry, Vol. 56, No. 2, p 181-185, February, 1984. 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Pollutant identification, *Antimony, *Arsenic, *Spectrometry, Molecular photoluminescence spectrometry, Hydrides, Heavy metals.

Molecular photoluminescence spectrometry is a very sensitive and selective method for the determination of some hydrides and has been used for the determination of antimony and arsenic. Both elements were generated as hydrides and irradiated with ultraviolet light. The broad continuous emission bands were observed in the ranges about 240-750 nm and 220-720 nm, and the detection limits were 0.6 ng and 9.0 ng for Sb and As, respectively. Some characteristics of the photoluminescence phenomenon were made clear from spectroscopic observations. After the interference study, the method was successfully applied to the determination of antimony in river water and seawater. The advantages of this method include wide dynamic range and good selectivity plus a low and stable background level. (Baker-IVI)
W84-03752

DETERMINATION OF TRACE ANIONS IN WATER BY MULTIDIMENSIONAL ION CHROMATOGRAPHY,
Environmental Research Lab., Athens, GA.
T. B. Hoover, and G. D. Yager.
Analytical Chemistry, Vol. 56, No. 2, p 221-225, February, 1984. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Ion chromatography, Selenium, Arsenic, Selenates, Senenites, Arsenates, Chlorides, Nitrates, Sulfates, Drinking water, Water quality control, Chromatography.

Selenate, selenite, and arsenate ions were separated from the major anions chloride, nitrate, and sulfate in drinking water, surface water, and groundwater souces by collecting a selected portion of the ion chromatograph, after suppression, on a concentrator column and reinjecting at the original chromatographic conditions. Statistical detection limits varied from 0.02 to 1.2 micrograms of trace element depending on the minor components to be separated and on the water matrix but independent of initial sample size from 2 to 10 ml. The maximum reliably separated molar ratio was 1300 for sulfate/selenate in well water. Carbonate-bicarbonate eluent compositions were optimized for each trace ion. The technique is not applicable to anions of weak electrolytes that are not retained by the concentrator, e.g., fluoride, cyanide, or arsenite. (Baker-IVI)
W84-03753

DETERMINATION OF LOW LEVELS OF BROMIDE IN FRESH WATER AFTER CHROMATOGRAPHIC ENRICHMENT,
Uppsala Univ. (Sweden). Dept. of Analytical Chemistry.
U. Lundstrom, A. Olin, and F. Nydahl.
Talanta, Vol. 31, No. 1, p 45-48, January, 1984. 5 Tab, 8 Ref.

Descriptors: *Bromide, *Fresh water, *Chromatographic enrichment, Sodium perchlorate, Chloride, Sweden.

A method has been developed for the determination of bromide in fresh water. The analyte is enriched on the anion-exchanger Dowex 1 x 8, which exhibits a considerably greater affinity for bromide than for the major anions in fresh water. Sodium perchlorate is used as eluent and an enrichment factor of about 100 can be achieved. The eluted bromide is oxidized with peroxodisulfate to bromate, which is determined iodometrically by a previously published spectrophotometric method. The enrichment in the presence of the major components of fresh water has been studied. Only bicarbonate has been found to interfere, but this interference can be avoided by acidifying the sample with hydrochloric acid. The recovery from synthetic fresh water with ionic concentrations corresponding to 0.005 equivalent/l and spiked with bromide was 100% at bromide concentrations larger than 50 n M (4 microg/l) and about 90% at 10 nM. The detection limit is 1.5 nM and the limit of determination 5 nM for 1-liter samples. (Author's abstract)
W84-03802

DIATOMS AS INDICATORS OF THE RATE OF LAKE ACIDIFICATION,

Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
M. Dickman, S. Dixit, J. Fortescue, B. Barlow, and J. Terasmae.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 375-386, January, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Diatoms, *Bioindicators, *Lake acidification, Hydrogen ion concentration, Sediments, Water pollution effects, Acid rain, History, Lakes, Acid water.

Autecological studies of diatoms as pH indicators have opened the way to estimating a lake's past pH on the basis of its diatom species composition and relative abundance. Estimating the rate of lake acidification from its sediment subfossil diatoms is possible when these subfossils can be identified and accurately enumerated in the surface sediments of 20 to 30 lakes. Once this is done the diatoms down the length of the sediment core of one or more of these lakes can be enumerated and the pH inferred at each depth. This technique holds considerable promise in assessing the temporal impact of acid precipitation for acid-sensitive lakes. When log values were regressed against observed pH for 28 lakes located north of Lake Superior, a significant ($P < 0.01$) correlation ($r = 0.89$) resulted. Down-core diatom stratigraphy for one of these lakes indicated that its pH had dropped from 6.2 to 5.2 over the last 2 yr while a second lake had dropped from a pH of 7.1 to 5.2 over the last 30 yr. The diatom inferred pH technique, when carefully calibratd in the study area in which it is used has proved to be a valuable tool in estimating the rate of lake acidification. (Murphy-IVI)
W84-03839

IDENTIFICATION OF CHLORINATED NITROBENZENE RESIDUES IN MISSISSIPPI RIVER FISH,
Food and Drug Administration, Washington, DC. Div. of Chemical Technology.
M. P. Yurawecz, and B. J. Puma.
Journal Association of Official Analytical Chemists, Vol. 66, No. 6, p 1345-1352, November, 1983. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Chlorinated nitrobenzene, *Mississippi River, *Fish, Industrial wastes, Bioindicators, Pesticides, Organochlorine, Organophosphorus,.

FDA monitoring programs for pesticide and industrial chemical residues in foods have included analyses of selected food samples, mainly of domestic fresh-water fish, for residues of electron-capturing industrial chemicals. These residues are recovered in the 6% ethyl ethel-petroleum ether eluate of the Florisil cleanup procedure, but are too volatile for electron capture gas chromatography analysis at the operating conditions recommended. Residues of lower chlorinated nitrobenzenes have been found at levels up to about 1 ppm in 8 samples of Mississippi River fish. Electron capture gas chromatography (EC/GC) was used for determination after extraction and cleanup using a procedure based on the AOAC multiresidue method for organochlorine and organophosphorus pesticides in nonfatty foods. The residues found included 2-, 3-, and 4-chloronitrobenzene and 2,3- and 3,4-dichloronitrobenzene, identify was confirmed by GC/mass spectrometry. GC retention times for 15 monochloro-through pentachloro-substituted nitrobenzene congeners were determined with OV-101 and mixed OV-101 + OV-210 columns at 130 degrees C. In studies of the nonfatty food extraction and cleanup procedures of the AOAC method, recoveries of 15 chlorinated nitrobenzenes from spiked fish samples ranged from 68 to 116%. GC of cleaned up fish extract aliquots equivalent to 20 mg sample allowed quantitation of individual congeners at levels of about 0.025 and 0.005 ppm with H-3 and Ni-63 EC detectors, respectively. The contamination of Mississippi River fish with chlorinated nitrobenzenes appears to be localized in a 150 mile section of the river extending from St. Louis, MO, to Cape Girardeau, MO; no chlorinated nitrobenzenes (< 0.005 ppm) were detected in Mississippi River fish caught above or below this region of the river or in fish from the lower Missouri River, which joins the Mississippi River near St. Louis. (Murphy-IVI)
W84-03866

DETERMINATION OF SULPHATE IN NATURAL WATER BY FLOW-INJECTION ANALYSIS,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, M. Yagi, M. Zenki, M. Doi, and K. Toei.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 1, p 29-31, 1984. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Sulfate, *Natural waters, *Flow-injection analysis, Cations, Ions, Japan.

Sulfate was determined in natural water samples by flow-injection analysis using dimethylsulfonazo-III as reagent. The interference by Ca was eliminated by a cation-exchanger column inserted directly after the sample injection valve. In order to ensure high sensitivity and reproducibility it was necessary to saturate the carrier solution with barium sulfate and to fill the reaction coil with ethanol-water (1:1) when not in use. Standard deviations were 0.94-1.2% for 6-10 mg/l sulfate. The limit of detection was about 0.2 mg/l. The calibration graph was linear up to 14 mg/l. Mg(2+), NH4(+), Na(+), K(+), Cl(-), NO3(-), PO4(3-), HCO3(-) and SiO3(2-) did not interfere in the normally occurring concentrations. (Author's abstract)
W84-03898

TRIBUTYLTIN DETECTION AT TRACE LEVELS IN WATER AND SEDIMENTS USING GC WITH FLAME-PHOTOMETRIC DETECTION AND GC-MS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
M. D. Mueller.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 1, p 32-36, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Tributyltin, *Trace levels, Sediments, Water analysis, Gas chromatography.

A sensitive and specific method for the determination of low levels of tributyltin (TBT) in water and sediments is presented. The procedure is based on the conversion of tributyltin compounds to tributylmethyltin (TBMeT) and analysis using GC with flame photometric detection (GC-FPD) and GC-MS. Detection limits of less than 1 ppt for water and 0.5 ppb for sediment are achieved. River and lake water and lake sediments analyzed show tributyltin to be present in the low ppt- and ppb-range, respectively. (Author's abstract)
W84-03899

SPECTROPHOTOMETRIC DETERMINATION OF NITRITE PRODUCED BY FLOW-ELECTROLYSIS OF NITRATE,
Fukui Univ. (Japan). Dept. of Chemistry.
R. Nakata.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 2, p 115-117, 1984. 6 Fig, 1 Tab, 12 Ref.
Japanese Ministry of Education, Science and Culture grant 57740288.

Descriptors: *Spectrophotometry, *Nitrite, Electrolysis, Ions, Natural waters, nitrate, Copper, Cadmium.

The electrocatalytic reduction of nitrate to nitrite with a carbon column electrode in the presence of Cu(2+) and Cd(2+) was investigated in a flow system. Electrogenerated nitrite was mixed with color-producing reagents and detected colorimetrically. In acetate and phosphate buffer solutions, the reduction of nitrate to nitrite or further reduction of nitrite was monitored by scanning the electrode potential. In phosphate buffer solutions, the yield of nitrite went up to a maximum in the presence of Cu(2+) and Cd(2+) at above -1.1 V. The electrocatalytic reduction method was applied to the determination of nitrate in river water instead of the conventional Cu-coated Cd column. (Author's abstract)
W84-03900

ION CHROMATOGRAPHY IN PRECIPITATION (IONEN-CHROMATOGRAPHIE IN NIEDERSCHLAGSWASSER),
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
K. P. Muller.
Fresenius Zeitschrift fur Analytische Chemie, No. 3-4, p 345-346, 1984. 3 Ref.

Descriptors: *Ion chromatography, *Rain water, Ions, Chromatography, Chemistry of precipitation, Anions, Cations.

Ion chromatography can successfully detect a number of anions and some cations from rain water. Improved separation efficiency and sensitivity was achieved by special column configuration and temperature stabilization. The following anions can be detected simultaneously: F(-), Cl(-), NO2(-), NO3(-), PO4(3-), Br(-), SO4(2-), HCOO(-), CH3COO(-). (Murphy-IVI)
W84-03901

INDIRECT TRACE DETERMINATION OF NTA IN NATURAL WATERS BY DIFFERENT PULSE ANODIC STRIPPING VOLTAMMETRY,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Angewandte Physikalische Chemie.
A. Voulgaropoulos, P. Valenta, and H. W. Nurnberg.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 367-371, 1984. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Nitrilotriacetic acid, *Natural waters, Measuring instruments, Voltammetry, Bismuth, Cadmium, Copper, Lead, Zinc, Iron.

Nitrilotriacetic acid (NTA) appears to be the most suitable substitute for sodium tripolyphosphate to prevent the eutrophication of natural waters. Bismuth(III) is added in excess in the water sample to NTA and EDTA to form inert stable complexes at pH 2. The uncomplexed Bi(III) is then deposited into a hanging mercury drop electrode at a potential of -0.15 V vs. SCE and subsequently stripped anodically in the differential pulse mode. The peak current of uncomplexed Bi(III) is recorded. By a second deposition at -0.35 V vs. SCE Bi(III) from Bi(3+) and Bi-NTA is deposited. The concentrations of NTA and EDTA in the sample are determined from the concentration of added Bi(III) and the voltammetrically determined Bi(III) at these two potentials by the standard addition method. Cd, Cu, Pb, and Zn do not interfere. Fe(III) has to be reduced by ascorbic acid or hydroxylamine before the determination. Cu(II) in concentrations larger than 40 microg/l has to be removed by preelectrolysis. In samples with chloride contents above 0.05 M the stripping step has to be performed after medium exchange to a perchloric acid solution of pH 2. For a deposition time of 2 min the determination limit is approximately 0.2 microg/l NTA and 0.1 microg/l EDTA. The relative standard deviation for NTA concentrations at 2 or 10 microg/l lies at 10 or 1.3%, respectively. Good accuracy is established by finding within 2% the levels adjusted when water samples are spiked with a standard solutions of NTA or EDTA. (Murphy-IVI)
W84-03904

FRESHWATER MOLLUSCS AS ACCUMULATION INDICATORS FOR MONITORING HEAVY METAL POLLUTION,
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Lehrstuhl fuer Biogeographie.
L. Zadory.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 375-379, 1984. 6 Fig, 2 Tab.

Descriptors: *Mollusks, *Bioindicators, *Heavy metals, Water pollution, Behavior, Synergistic effects, Cadmium, Lead, Zinc, Saar River, Federal Republic of Germany.

For monitoring heavy metal pollution of streams in urban and industrial areas residue analyses were undertaken in different aquatic invertebrates with

special regard to the freshwater mollusks Bithynia tentaculata, Physa acuta, Radix peregra and Dreissena polymorpha to define the heavy metal residues in shell and soft body parts in natural populations. To control the distribution and dynamics of the heavy metals, the accumulation and elimination behavior is determined after experimental contamination tests with cadmium, lead and zinc and their complexes for synergisms on standardized populations under laboratory conditions. Due to a strong accumulation of these organisms they appear to be well suited for monitoring programs. Experimental studies show, that zinc and lead absorbed with the food accumulate in the hemolymph, the food muscle and the protein gland. The different rates of accumulation depend however among others on the different physiological variables as well as on population specific strategies. Furthermore, different mechanisms result in a rivalry among the heavy metals for uptake. (Author's abstract)
W84-03905

NITRATE IN DRINKING WATER OF WINE-GROWING AREAS - AN ION-CHROMATOGRAPHIC STUDY (NITRAT IM TRINKWASSER VON WEINBAUGEBIETEN - EINE IONEN-CHROMATOGRAPHISCHE STUDIE),
Goettingen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
T. Darimont, G. Schulze, and M. Sonneborn.
Fresenius Zeischrift fur Analytische Chemie, Vol. 317, No. 3-4, p 400-406, 1984. 7 Fig, 2 Tab, 51 Ref.

Descriptors: *Nitrate, *Drinking water, Ion chromatography, Farm wastes, Fertilizers, Wine orchards, Water pollution, Oberrhein, Main, Neckar, Federal Republic of Germany.

Wine-growing uses extremely high doses of nitrogenous fertilizer which can influence the quality of drinking water when washed out. To quantify the problem of burdening, drinking water was sampled from taps at 254 sites covering the wine-growing areas of Oberrhein, Main and Neckar. These samples were examined for their content of nitrate by means of ion-chromatography. 13% of the samples exceed the maximal concentration admissible and 42% are above guide levels. For the regions of Wurzburg, Wurttembergisch Unterland and Kaiserstuhl-Tuniberg-Markgraflerland which are particularly loaded with nitrate it can be proved that artificial fertilizers do indeed influence the quality of drinking water. In these cases a dependence of nitrate concentration in drinking water on the local situation of the water catchment places - in view of areas used for wine-production is given. A nitrate register for drinking water was established; it shows that parts of the population, who are particularly concerned, are additionally nitrate-burdened through drinking water by a factor of approximately four in comparison with other foods. A critical examination of purely immission-covering possibilities for the reduction of nitrate burdening leads to the necessity of regulations for limiting the emissions. (Murphy-IVI)
W84-03906

COMPARISON OF CONTINUOUS-FLOW (CFA) AND FLOW-INJECTION (FIA) TECHNIQUES FOR THE PHOTOMETRIC DETERMINATION OF TRACES OF ALUMINIUM IN WATER AND SOIL SAMPLES (VERGLEICH VON CONTINUOUS-FLOW-UND FLOW-INJECTION-ANALYSENTECHNIKEN ZUR PHOTOMETRISCHEN BESTIMMUNG VON ALUMINIUMSPUREN IN WASSERN UND BODEN),
Goettingen Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
D. Zoltzer, and G. Schwedt.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 422-426, 1984. 9 Fig, 3 Tab, 2 Ref.

Descriptors: *Continuous flow, *Flow injection, Comparison studies, Aluminum, Water analysis, Soil analysis.

The determination of aluminum is carried out by means of Chromazurol S. Interferences by iron(III) are eliminated by reduction with ascorbic acid. FIA shows more symmetric signals than CFA. By FIA also higher sample frequencies and better reproducibility are obtainable. Only Teflon tubes should be used for the analytical systems because of the adsorption of Al on glass surfaces. Detection limits are about 10 ng/ml of Al. In case of soil solutions and water samples the evaluation has to be performed according to the standard addition method as considerable matrix effects are caused by the organic substances. Only kinetically labile aluminum is determinable. Therefore, comparisons with atomic absorption determinations are presented. Correlations between pH-values of the soil solutions and the part of photometrically determinable aluminum are recognizable. (Author's abstract)
W84-03907

CHLOROPHYLL A TROPHIC STATUS CLASSIFICATION SYSTEM FOR SOUTH AFRICAN IMPOUNDMENTS,
Rhodes Univ., Grahamstown (South Africa). Dept. of Plant Sciences.
R. D. Walmsley.
Journal of Environmental Quality, Vol. 13, No. 1, p 97-104, 1984. 5 Fig, 3 Tab, 30 Ref.

Descriptors: *Chlorophyll a, *Trophic level, *Lake classification, *Reservoirs, Eutrophication, Water management, Algal blooms, Bioindicator, South Africa.

The use of chlorophyll a as an index of trophic status is based on the fact that it is normally the most abundant and important pigment in phytopankton cells; thus, measurements provide a convenient estimate of the phytoplankton biomass in a water body. Chlorophyll a data from 24 South African impoundments were examined with the objective of developing a trophic status classification system. For the combined data set, standard deviation of the mean annual chlorophyll a concentration displayed an almost 1:1 linear relationship to the mean, indicating a wide annual variation in chlorophyll a for most impoundments. There appeared to be no common seasonal pattern to the occurrence of chlorophyll a maxima and minima, leading to the conclusion that trophic status was best described by a statistical parameter based on annual data (notably the mean value). Statistically significant empirical formulae that relate both the maximum value and the frequency of occurrence of specific chlorophyll a ranges to the mean annual value were established, and their potential use in the assessment of trophic status and impoundment management is described. (Murphy-IVI)
W84-03940

APPLICATION OF SOME BENTHIC INDICES FOR QUALITY EVALUATION OF WATER HIGHLY POLLUTED WITH MUNICIPAL SEWAGE,
Polish Academy of Sciences, Warsaw. Dept. of Ecological Bioenergetics.
M. Kaniewska-Prus, and A. Kidawa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 263-269, 1983. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Water pollution, *Pollutant identification, *Municipal wastes, *Vistula River, *Warsaw, *Poland, Benthic environment, Chemical analysis, Wastewater pollution.

Several commonly used benthic indices describing the degree of water pollution were calculated for four sites of polysaprobic section of the Vistula River below Warsaw, Poland. No significant differences were found in values of these indices between sites. All indices for the four sites showed typical values for highly polluted waters. The lack of change along the 25 km stretch between the first and last site indicate that self purification is not occurring to any significant degree. No significant correlations were found between values of these factors and the chemical properties of the water. The average Chandler's score turned out to be the best for evaluating waters strongly polluted with municipal sewage. It was the least sensitive to water level changes in the river and to seasonal changes in macrobenthos numbers. (Baker-IVI)
W84-03990

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; IV. ANALYTICAL TECHNIQUES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. E. McIntyre, and J. N. Lester.
The Science of the Total Environment, Vol. 27, No. 2/3, p 201-230, April, 1983. 196 Ref. Science and Engineering Research Council Grant GR/B/18263.

Descriptors: *Organic compounds, *Pollutant identification, *Analytical methods, Chromatography, Wastewater analysis, Water analysis, Drinking water, Spectrometry, Literature reviews.

Methods currently available for the determination of organic micropollutants in water and wastewater are evaluated in this review. The groups of compounds considered are those which appear in both the EEC Blacklist and Greylist and the U.S. EPA Priority Pollutant list. These include specifically, polynuclear aromatic hydrocarbons, phlychlorinated biphenyls, organochlorine insecticides, phthalic acid esters, chlorophenols, phenols, organophosphorus compounds and other selected compounds of concern. General measures of organic pollution are considered, together with a range of chromatographic and instrumental methods for the analysis of specific groups of pollutants. The most widely used techniques for the measurement of specific compounds are gas liquid chromatography and high performance liquid chromatography. Mass spectrometry and combined gas liquid chromatography/mass spectrometry are the most definitive analytical methods. Solvent extraction procedures are the most suitable for non-volatile organic substances, and gas purging or stripping techniques are favored for the isolation of volatile compounds. Sample purification or clean-up procedures, including column and thin layer chromatography, are of particular importance when waste water samples are to be analyzed, owing to the relatively high concentrations of extraneous materials which have to be removed prior to analysis. (Baker-IVI)
W84-03996

POLLUTION INDICATORS AND POTENTIAL PATHOGENIC MICROORGANISMS IN ESTUARINE RECREATIONAL WATERS,
Nova Scotia Research Foundation, Dartmouth.
W. J. Robertson.
Canadian Journal of Public Health, Vol. 75, No. 1, p 19-24, January/February, 1984. 50 Ref.

Descriptors: *Bioindicators, *Pathogenic bacteria, *Estuaries, *Recreation, Water quality, Pathogens, Fecal coliform, Coliforms, Bacteria, Vibrio parahaemolyticus, Pseudomonas aeruginosa, Salmonella, Candida albicans, Canada.

The quality of marine recreational waters is now assessed using fecal coliforms, the recognized indicator of fecal contamination. It is assumed that the possibility of infections from water-borne pathogens increases as densities of fecal coliform increase. Fecal streptococci are also used as supplementary indicators. However, these indicators possess certain traits which limit their applicability. Within the last few years relatively easy techniques for enumerating the more common water-borne pathogens themselves have been developed, eg. Candida albicans, Pseudomonas aeruginosa, Salmonella and Vibrio spp. Studies are now underway to determine whether their densities correlate well with the presence of fecal indicators, in marine recreational waters. In estuaries the potential pathogen Vibrio parahaemolyticus appears to hold promise as a complementary indicator of the presence of sewage and other potential pathogens. (Author's abstract)
W84-04009

BACTERIAL INDICATORS OF RECREATIONAL WATER QUALITY,
Health Effects Research Lab., Cincinnati, OH.
A. P. Dufour.
Canadian Journal of Public Health, Vol. 75, No. 1, p 49-56, January/February, 1984.

Descriptors: *Bacteria, *Bioindicators, Water quality, Recreation, Escherichia coli, Enterococci, Coliforms, Fecal coliforms, Human pathology, Gastroenteritis, Comparison studies.

The currently recommeded bacterial indicator for measuring the quality of recreational waters in the United States is the fecal coliform group. Correlation analysis was performed on the swimming-associated gastroenteritis rates and the corresponding geometric mean densities of each indicator from multiple beaches and study units. The correlation coefficient was used as the measure of the 'strength' of the relationship between each indicator of water quality and swimming-associated gastroenteritis. The results of the marine and freshwater studies indicate that one bacterial indicator (enterococci) meets most of the ideal characteristics. Most important is the fact that the density of this indicator correlated well with gastrointestinal disease associated with swimming. The regression line of swimming-associated gastrointestinal illness rates on enterococci density indicates that the illness rate approaches zero before the indicator density reaches one. E. coli density showed a strong relationship to health risk in freshwater, but not in seawater whereas fecal coliform density was not related to swimming-associated gastroenteritis in either aquatic environment. Although none of the indicators examined could fulfill all of the suggested characteristics, enterococci were able to meet more of them than E. coli or fecal coliforms. The epidemiologic method does not require establishing pathogen to indicator relationships since only illness incidence is measured. (Murphy-IVI)
W84-04012

SIMULTANEOUS DETERMINATION OF DISSOLVED ORGANIC CARBON AND PHOSPHORUS IN WATERS USING FLAME IONIZATION AND PHOTOMETRIC DETECTORS,
Government Industrial Research Inst., Tosu (Japan).
K. Nakajima.
Water Resources, Vol. 18, No. 5, p 555-559, 1984. 4 Fig, 3 Tab, 16 Ref.

Descriptors: *Simultaneous determination, *Flame ionization, *Photometry, Dissolved organic carbon, Dissolved phosphorus, Organic carbon, Phosphorus, Water quality.

An apparatus with flame ionization and photometric detectors was assembled for the simultaneous determination of dissolved organic carbon (DOC) and phosphorus (DP) in waters. The optimum operating conditions were described. The long-term precision (relative standard deviation) is 5.8% for DOC and 5.2% for DP. The detection limits are 0.09 microg/ml for DOC and 0.03 microg/ml for DP. The responses for various DOC and DP compounds agreed almost with those obtained by combustion-infrared and persulfate digestion-colorimetric methods, respectively. DOC and DP in several water samples were determined by this method and other methods, and the results obtained by those methods were discussed. (Author's abstract)
W84-04022

ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF ARSENITE IN WATER SAMPLES BY GRAPHITE FURNACE AFTER EXTRACTION WITH AMMONIUM SEC-BUTYLDITHIOPHOSPHATE,
Texas A and M Univ., College Station. Dept. of Chemistry.
D. Chakraborti, K. J. Irgolic, and F. Adams.
Journal Association of Official Analytical Chemists, Vol. 67, No. 2, p 277-280, March-April, 1984. 2 Fig, 3 Tab, 20 Ref.

Descriptors: *Arsenite, Water analysis, Atomic absorption spectrophotometry.

Arsenite-but not arsenate, methylarsonic acid, or dimethylarsinic acid-is extracted from water samples by 5 mL of a 0.01M hexane solution of sec-dibutylthiophosphate. A 10 microL aliquot of the extract is injected into an atomic absorption spectrometer with a graphic furnace for the determination of arsenic. The calibration curve is linear to 1500 ng As. Quantities of arsenic as low as 100 ng As (0.2 ppb As when contained in 500 mL) can be confidently determined. The method was tested with natural river water and synthetic river water. The relative standard deviations associated with the recoveries of arsenite from natural water and synthetic river water spiked with arsenite range from 4.8 to 8.0%. Ten to 15 arsenite determinations can be completed in 1 h. (Author's abstract)
W84-04032

SAMPLING STRATEGY FOR RIVER POLLUTANT TRANSPORT,
Corps of Engineers, Buffalo, NY. Buffalo District.
S. M. Yaksich, and F. H. Verhoff.
Journal of Environmental Engineering, Vol. 109, No. 1, p 219-231, February, 1983. 3 Fig, 5 Tab, 7 Ref, 1 Append.

Descriptors: *Sampling strategy, *River flow, *Pollutant transport, Event response rivers, Stable response rivers, Suspended sediments, Phosphorus, High flow.

Estimates of the amount of pollutants which are carried by rivers from land sources to receiving water bodies are calculated from measurements of river flow rate and pollutant concentration. River flow can be measured frequently, but pollutant concentration will usually be sampled infrequently during the period of transport. A strategy is developed for sampling the pollutant concentration so that the errors in the transport estimates are minimal. Two types of rivers exist: event response rivers where suspended sediment concentrations and sediment adsorbed parameters increase with increasing flow; and stable response rivers where suspended sediment and adsorbed parameter concentrations do not increase with increasing flow. Each type of river requires its own sampling strategy. High flow events must be sampled on event response rivers to obtain reliable suspended sediment and total phosphorus flux estimates. The best method to calculate the flux with this data is an interval method. If these events are not sampled, fluxes will be underestimated by 15%-30%. Event sampling is not important for event response rivers which are impacted by point sources. For stable response rivers and parameters which do not change with flow, event sampling is not required. (Moore-IVI)
W84-04050

ANALYSIS OF TETRAHYDROTHIOPHENE IN WATER BY HEADSPACE HIGH-RESOLUTION GAS CHROMATOGRAPHY-MASS SPECTROMETRY,
Istituto di Ricerche Farmacologiche Mario Negri, Milan (Italy). Lab. of Environmental Pharmacology and Toxicology.
G. Carlucci, L. Airoldi, and R. Fanelli.
Journal of Chromatography, Vol. 287, No. 2, p 425-428, April, 1984.

Descriptors: *Tetrahydrothiophene, Sulfur compounds, Water pollution, Leachates, Gas chromatography.

Tetrahydrothiophene (THT) is widely used as a warning odorant for odorless fuel, city and natural gases and recently also for herbicides. Headspace gas chromotography was developed to monitor THT contamination of soil and spring-waters surrounding an area where a container had been incorrectly disposed. The procedure is highly sensitive to quantitate THT in water. The method appears to be useful for detecting water contamination by THT at levels as low as 10 ng/ml. (Murphy-IVI)
W84-04052

DETERMINATION OF TRACE LEVELS OF HEAVY METALS IN WATERS BY EXTRACTION WITH AMMONIUM TETRAMETHYLENEDITHIOCARBAMATE AND HEXAMETHYLENEAMMONIUM HEXAMETHYLENEDITHIOCARBAMATE INTO XYLENE FOLLOWED BY INDUCTIVELY-COUPLED PLASMA EMISSION SPECTROMETRY,
National Research Inst. for Pollution and Resources, Ibarkai (Japan).
H. Tao, A. Miyazaki, K. Bansho, and Y. Umezaki.
Analytica Chimica Acta, Vol. 156, p 159-168, 1984. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Trace metals, *Metals, *Water analysis, Heavy metals, Spectrometry, Plasma emission spectrometry, Extraction, Sea water, Rivers.

The usefulness of extraction with ammonium tetramethylenedithiocarbamate (APDC)/hexamethyleneammonium hexamethylenedithiocarbamate (HMAHMDC)/xylene extraction system for the determination of ng/ml levels of metals in natural waters is demonstrated. Determinations of cadmium, copper, chromium, cobalt, iron, manganese, molybdenum, nickel, lead, vanadium, and zinc are described in river and sea water using inductively-coupled plasma emission spectrometry following the extraction step. The main advantages of the method are the simultaneous extraction of the metals in a single extract and simultaneous multi-element measurements by direct introduction of the organic phase into the plasma, without back-extraction or evaporation of the extract which is liable to increase contamination and losses by adsorption or evaporation. The limits of detection of the method range from 0.017 ng/ml (cadmium) to 0.5 ng/ml (lead). Nitric acid and ammonia solution were super-special grade and HMAHMDC was used without purification. If these reagents are purified, the blank will be decreased and better detection limits will be achieved. With 100-fold concentration factors, calibration graphs are linear up to 30 ng/ml or more. (Baker-IVI)
W84-04059

ATOMIC ABSORPTION SPECTROMETRIC DETERMINATION OF ARSENIC AND SELENIUM IN MINERAL WATERS BY ELECTROTHERMAL ATOMIZATION,
Ljubljana Univ. (Yugoslavia). Dept. of Chemistry and Chemical Technology.
V. Hudnik, and S. Gomiscek.
Analytica Chimica Acta, Vol. 157, No. 1, p 135-142, February, 1984. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Pollutant identification, Water analysis, Arsenic, Selenium, Minerals, Electrothermal atomization, Atomic absorption spectrometry, Spectrometry, Mineral water, Slovenia, Yugoslavia.

The determination of arsenic and selenium by electrothermal atomic absorption spectrometry is complicated by interferences because of the uncontrollable volatility of arsenic and selenium compounds, especially in complex inorganic and organic matrices. Mineral waters contain alkali metals, alkaline-earth metals, sulfate, chloride, and hydrogen carbonate ios in high and changeable concentrations, whereas the concentrations of arsenic and selenium are normally very low. Arsenic and selenium are separated from the macrocomponents by co-precipitation in hydrated iron (III) oxide. The precipitate is dissolved in 0.2 M sulfuric acid for injection. The detection limits are 0.2 and 0.5 micrograms/l for arsenic and selenium, respectively. The proposed method was used in the analysis of some mineral waters from Slovenia (Yugoslavia). (Baker-IVI)
W84-04060

SEPARATION OF TELLURIUM(IV) FROM WATER AND SEA WATER BY FLOTATION WITH HYDRATED IRON(III) OXIDE,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
S. Nakashima, and M. Yagi.
Analytica Chimica Acta, Vol. 157, No. 1, p 187-191, February, 1984. 1 Tab, 28 Ref.

Descriptors: *Pollutant identification, *Trace elements, *Tellurium, Atomic absorption spectrometry, Spectrometry, Flotation, Separation, Water analysis, Seawater.

A flotation separation method is described for determining sub-microgram levels of tellurium(IV) from 1 liter samples of water and sea water. Tellurium(IV) is coprecipitated with hydrated iron(III) oxide at pH 8-9. The precipitate is floated with the aid of surfactant solutions and small nitrogen bubbles, separated and dissolved in dilute hydrochloric acid. Tellurium is then converted to hydrogen telluride with sodium tetrahydroborate and measured by atomic absorption spectrometry. Recovery of added tellurium (0.4 and 0.8 micro g/l) was about 83%. The time required for the preconcentration is 30 min per sample, including 15 min stirring. The atomic absorption measurement of hydrogen telluride is rapid and sensitive. (Baker-IVI)
W84-04061

CALIBRATION AND APPLICATION OF QUAL-II TO THE LOWER WINOOSKI RIVER,
Massachusetts Univ., Amherst. Dept. of Environmental Engineering.
J. Van Benschoten, and W. W. Walker, Jr.
Water Resources Bulletin, Vol. 20, No. 1, p 109-117, February, 1984. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Water quality, *Computer models, *QUAL-II, *Lower Winooski River, *Vermont, Simulation, Phosphorus, Algae, Dissolved oxygen, Nitrogen compounds, Nutrients, Dam effects.

A modified version of the QUAL-II water quality simulation model is calibrated and applied to the Lower Winooski River, Vermont. The Winooski River flows westerly through the Green Mountains to Lake Champlain. In constrast to the upper basin, which is predominantly rural, the final 32 km, the Lower Winooski has a population of about 90,000. Waste discharges from seven municipalities and one industry enter the Lower Winooski. There are two dams on the Lower Winooski for peak power generation. Several structural modifications are made in the model to improve water quality simulations in rivers impacted by algal growth; these include the addition of organic nitrogen and organic phosphorus compartments and provision for algal uptake of ammonia and/or nitrate nitrogen. The model is interfaced with statistical programs which facilitate tabulation, display, and analysis of observed and predicted concentrations. The model is calibrated and tested against data from two intensive water quality surveys. In applying the revised QUAL-II model to the Lower Winooski River, good agreement is evident between observed and predicted water quality constituents. From a water quality management standpoint, use of the model has helped in defining the importance of algae and point-source phosphorus inputs as factors influencing the Lower Winooski's dissolved oxygen regime. (Moore-IVI)
W84-04111

ENUMERATION OF BACTEROIDES FRAGILIS GROUP ORGANISMS FROM SEWAGE AND NATURAL WATERS,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
K. Allsop, and D. J. Stickler.
Journal of Applied Bacteriology, Vol. 56, No. 1, p 15-24, February, 1984. 8 Tab, 30 Ref.

Descriptors: *Bacteroides, *Bacterial analysis, *Water analysis, *Wastewater analysis, Feces, Indicator organisms, Coliforms, Membrane filtration.

The Bacteroides fragilis group (BFG) contains obligately anaerobic, Gram negative, non-motile, non-sporing bacteria. These species, the most numerous bacteria in human feces, are also known to occur in the intestinal tract of some warm blooded animals. Their presence in human feces in numbers approximately 100-fold greater than those of Escherichia coli suggests that Bacteroides spp. might be an alternative to coliform organisms as indicators of fecal contamination of water. A membrane filtration technique has been developed for the enumeration of BFG organisms from sewage and natural waters. The method used Wilkins and Chalgren agar medium supplemented with gentamicin, penicillin, aesculin and ferric ammonium citrate. Membrane filters with 0.22 micro m pores were significantly more efficient than those with 0.45 micro m pores in the isolation of BFG. A preliminary incubation period of 4 h at 30 C prior to 44 h at 37 C yielded significantly higher numbers of BFG than direct incubation at 37 C for 48 h. (Moore-IVI)
W84-04163

NEW GENERAL ESTIMATION OF RIVER POLLUTION USING NEW DIATOM COMMUNITY INDEX (NDCI) AS BIOLOGICAL INDICATORS BASED ON SPECIFIC COMPOSITION OF EPILITHIC DIATOMS COMMUNITIES. APPLIED TO ASANO-GAWA AND SAIGAWA RIVERS IN ISHIKAWA PREFECTURE,
Meiho High School, Kanazawa City (Japan).
For primary bibliographic entry see Field 5C.
W84-04170

INDIRECT DETERMINATION OF CYANIDE IN WATER BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY,
Shanghai Normal Univ. (China). Dept. of Chemistry.
B.-X. Xu, T.-M. Xu, and Y.-Z. Fang.
Talanta, Vol. 31, No. 2, p 141-143, February, 1984. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Cyanide, *Atomic absorption spectrophotometry, Lead, Anions, Industrial wastewater, Huang Pu River, China.

The standard method for determining trace cyanide in water is colorimetry, but it involves preseparation and use of a carcinogenic reagent (benzidine). An indirect method for determination of trace cyanide in water by atomic-absorption spectrophotometry is described. Cyanide forms a stable complex anion with Pd in alkaline solution. This complex anion can form an ion-association complex with tetra-alkylammonium ions which can be extracted into n-butyl alcohol with an efficiency higher than 90%. The extract can be analysed directly for palladium (and hence indirectly for cyanide) by flame atomic-absorption spectrophotometry. The detection limit for cyanide by this method is 0.1 microg/ml in the n-butyl alcohol extract. Beer's law is obeyed for 0.13-9 microg of CN(-) per ml of n-butyl alcohol. Several foreign ions do not interfere. (Murphy-IVI)
W84-04187

5B. Sources Of Pollution

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF A HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM; II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM; II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Technischen Umweltechutz.
V. G. Gunkel.
Archiv fur Hydrobiologie, Vol. 1, p 130-168, Stuttgart, January, 1984. 16 Fig, 6 Tab, 60 Ref.

Descriptors: *Herbicides, *Toxicity, *Ecosystems, Atrazine, S-triazine, Bioaccumulation, Phytoplankton, Benthic fauna, Fish, Fate of pollutants, Food chains.

Herbicides are currently extensively used throughout developing countries. Although it is known what effects herbicides have on the specific target species, the general effects to the ecosystem is not widely studied. To determine the bioaccumulation of the herbicide (atrazine, s-triazine), a small pond was investigated during a vegetation period. The herbicide residues were determined in organisms at different trophic levels (phytoplankton, macrophytes, zooplankton, and fishes). High bioconcentration factors occur in phytoplankton during periods of small phytoplankton biomasses. Organisms of high trophic levels only reach small bioconcentration factors, and no food-chain effect can be observed under consideration of benthic and pelagic consumers. The phytoplankton accumulates atrazine to a varying level, ranging from 27 up to 1200. The level of the atrazine residue is not closely correlated with the phytoplankton species. High bioconcentration factors occur only in small phytoplankton biomasses. Daphnia pulicaria (Cladocera), a filtering zooplankton organism, accumulates less atrazine than phytoplankton; bioconcentration factors are less than 16. In water-free, dried bottom which consists mainly of organic material, concentration factors of 20 to 45 are observed. Larvae of sediment-eating Chironomus possess atrazine residues smaller than those found in the sediment with bioconcentration factors of 1.4 to 4.8. Fishes as final consumers of the experimental system possess only small bioconcentration factors, less than 9. Most of the herbicide is dissolved in the water with other losses to plants, animals, the sediment, the air and outflow. At the end of the experiment atrazine is distributed between the compartments of the pond system - water, sediment, atmosphere, phytoplankton, and zooplankton in the ratio 11400:660:5:2:1. (Murphy-IVI)
W84-03514

SEASONAL CHANGES IN THE CONCENTRATION AND COLOUR OF HUMIC SUBSTANCES IN SOME AQUATIC ENVIRONMENTS,
Laval Univ., Quebec. Dept. of Soil Science.
S. A. Visser.
Freshwater Biology, Vol. 14, No. 1, p 79-87, February, 1984. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Concentration, *Color, *Humic acids, Aquatic environment, Organic matter, Fulvic acids, Precambrian shield, Quebec.

Over 40% of the organic matter present in natural waters consists of complex heterogenous yellow or brown acidic polymers collectively known as humic matter. Between February and September 1974, concentrations of fulvic and humic acids in waters from a cryoboreal region of the Precambrian Shield in Quebec varied between 0.5-6.1 mg/l and 0.1-6.5 mg/l respectively. Whereas the fulvic acids usually remained relatively constant during this period, humic acids showed appreciable increases. The number and weight average molecular weights of the fulvic acids (approximately 5000 and approximately 22,000 daltons respectively) were lower than those of the humic acids (approximately 20,000 and approximately 75,000 respectively). The average molecular weight of the aquatic humic matter often decreased during late summer and early autumn. During spring floods the molecular weight of fulvic acids increased and that of humic acids declined. Because the aquatic humic acids were more intensely colored than fulvic acids, they contributed more than 30% of the color of the water even though they accounted for only 15% of the concentration of humic matter. The color intensity of both fulvic and humic acids generally appeared to increase during the latter part of the summer, when there was normally a decrease in the value of the color quotient (E4/E6 ratio), indicating the accumulation in the waters of more humified material. (Murphy-IVI)
W84-03532

DISSOLVED HEAVY METALS IN A LACUSTRINE MINE TAILINGS DEPOSIT-BUTTLE LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. F. Pedersen.
Marine Pollution Bulletin, Vol. 14, No. 7, p 249-254, 1983. 2 Fig, 2 Tab, 10 Ref. Natural Sciences and Engineering Research Council of Canada grant UO139.

Descriptors: *Heavy metals, *Mine wastes, *Lacustrine wastes, *Buttle Lake, *British Columbia, Zinc, Copper, Cadmium, Lakes, Open-pit mining, Mine drainage, Pollution load, Sedimentation.

The degree of post-depositional (diagenetic) reactivity of submerged mine tailings in fresh water in Buttle Lake, British Columbia, is assessed by inves-

tigating the distribution of Zn, Cu, Cd, Mn and Fe in interstitial water profiles collected from the upper meter of the tailings deposit and from proximal natural sediments. These dissolved Zn, Cu and Cd concentrations indicate that the tailings are not releasing heavy metals to the overlying lake water at present, and there is no evidence to suggest that significant oxidation is occurring in the deposit. The lake waters are enriched in metals from surface drainage, however, while pore waters in natural sediments are heavy-metal-depleted. Diffusion into the natural sediments therefore tends to buffer the lacustrine metal load, but only to a very limited extent. Modern open-pit mining operations often generate large quantities of mill tailings. Terrestrial disposal of this waste is expensive and may have serious environmental consequences, including surface water contamination from acidic drainage enriched in leached heavy metals. Submarine disposal, in contrast, is relatively inexpensive and has often been justified on the grounds that tailings have low chemical reactivity in marine or lacustrine waters. As a result coastal and inland waters in many areas of the world are being used increasingly as tailings disposal sites. However, recent field and laboratory studies have demonstrated that under certain conditions, tailings do release dissolved metals upon exposure to seawater. (Murphy-IVI)
W84-03536

LEVELS OF ORGANOCHLORINE COMPOUNDS IN AN INLAND SEAL POPULATION IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
E. Helle, H. Hyvarinen, H. Pyysalo, and K. Wickstrom.
Marine Pollution Bulletin, Vol. 14, No. 7, p 256-260, 1983. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Organochlorine compounds, *Seal populations, *Finland, Saimaa seals, Polychlorinated biphenyls, DDT, Chlordane, Chlorophenol, Population exposure, Ecological effects, Water pollution effects, Bioaccumulation, Lake Saimaa.

The Saimaa seal population has decreased rapidly in recent decades and the population is now estimated to be only 100-odd individuals. Until now the possible role of environmental toxins in the reduction of the Saimaa seal population has remained undetermined. Fourteen Saimaa ringed seals (Phoca hispida saimensis) were studied for PCB, DDT, chlordane and chlorophenol compounds in blubber, liver, muscle, heart and kidney in Lake Saimaa, eastern Finland, in 1977-1981. Both PCBs and total DDT increased on average from a good 5 mg/kg in extractable fat of blubber in a new-born to a good 65 mg/kg in sexually mature specimens, the maximum being 93 and 104 mg/kg respectively. Concentrations of PCBs and tDDT in blubber and liver were most clearly dependent on the age and weight of the seal. Chlordanes were found in all 14 specimens (mean 0.59 mg/kg in blubber), trichlorophenol in one, tetrachlorophenol in two and pentachlorophenol in all three specimens studied. Although some of the Saimaa seals had reached quite high levels of both PCBs and tDDT, the present results do not indicate that the steady decrease of the Saimaa seal population during the last two decades would have been caused by these toxins, at least not in isolation. (Murphy-IVI)
W84-03538

HEAVY METALS IN MARINE NEMATODES: UPTAKE, TISSUE DISTRIBUTION AND LOSS OF COPPER AND ZINC,
Newcastle upon Tyne Univ. (England). Dept. of Zoology.
R. Howell.
Marine Pollution Bulletin, Vol. 14, No. 7, p 263-268, 1983. 3 Fig, 2 Tab, 18 Ref.

Descriptors: *Heavy metals, *Nematodes, *Tissue analysis, *Copper, *Zinc, Bioindicators, Hypodermis, Cuticle, Fate of pollutants, Budle Bay, Blyth estuary, Estuaries, Bioaccumulation, Seawater, England.

The uptake and loss of copper and zinc was studied in two species of marine nematode from a non-polluted site and in one species from a polluted site. Copper and zinc concentrations were measured during and after accumulation from seawater in six different tissues of the nematodes. The rapid uptake and loss of both copper and zinc by the cuticle of all three groups suggests that the primary event is surface adsorption. The role of the 'other tissues' is difficult to assess. This group included the hypodermis which is known to be highly metabolically active and as well as secreting the cuticle is thought to be the site of many physiological processes in the body. As such it represents a highly specific target for toxicants of the heavy metal type, which are known to interfere with a wide variety of enzymes and cellular systems. (Murphy-IVI)
W84-03540

OLD CANNERY WASTES, A POTENTIAL SOURCE OF TRACE METALS IN THE MARINE ENVIRONMENT,
Northwest Consultant Oceanographers, Inc., Seattle, WA.
L. C. Loehr, and E. E. Collias.
Marine Pollution Bulletin, Vol. 14, No. 10, p 392-394, 1983. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Trace metals, *Cannery wastes, *Marine environment, Lead, Zinc, Mussels, California, Monterey Bay, Cypress Point, Cannery Row, Wastewater outfall, Bioaccumulation, Fate of pollutants, Wastewater pollution.

High levels of lead and zinc have been measured in the California Mussel Mytilus californianus taken from southern Monterey Bay as part of the California State Mussel Watch program. The levels of lead and zinc increase steadily from Cypress Point towards Cannery Row. The California State Water Resources Control Board (which funded but did not conduct the State Mussel Watch) has attributed the high levels to heavy metals contributed by sewage. The state mussel watch data reports have not considered the historic canning wastes from more than 30 canneries along Cannery Row as a possible source of trace metals. Leachates from old cannery wastes may be a major source of lead and zinc in mussels in southern Monterey Bay and must be considered in assessing any data from the State Mussel Watch program. (Author's abstract)
W84-03542

TOTAL MERCURY, METHYL MERCURY AND SULPHIDE IN RIVER CARRON SEDIMENTS,
Leicester Polytechnic (England). School of Chemistry.
P. J. Craig, and P. A. Moreton.
Marine Pollution Bulletin, Vol. 14, No. 11, p 408-411, 1983. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Mercury, *Methyl mercury, *Sulfide, *Carron River, *Sediments, Wastewater disposal, Fate of pollutants, Estuaries, Scotland.

Methyl mercury levels are controlled more by the sulfide content in sediments than by factors such as total mercury levels or organic content. Total mercury, methyl mercury and sulfide contents of River Carron sediments (Lothian, Scotland) have been determined. Total mercury concentrations are comparable to other mercury polluted estuaries in the UK, but the methyl mercury values for low-sulfide Carron sediments are generally higher. The methyl mercury levels are initially in direct proportion to the sulfide concentrations of the sediments but beyond sulfide concentrations of 1.8 mg/g the methyl mercury levels decline sharply. (Murphy-IVI)
W84-03543

AERIAL FLUX OF PARTICULATE HYDROCARBONS TO THE CHESAPEAKE BAY ESTUARY,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
D. B. Webber.
Marine Pollution Bulletin, Vol. 14, No. 11, p 416-421, 1983. 2 Fig, 1 Tab, 47 Ref. EPA grant X00322501.

Descriptors: *Particulate matter, *Hydrocarbons, *Chesapeake Bay, *Estuaries, Deposition, Municipal wastewater, Water pollution, Air pollution effects, Fate of pollutants, Air pollution.

To delineate the magnitude of the atmospheric input of high molecular weight hydrocarbons, deposition rates were measured over a 15 month period at four stations in south-eastern Virginia surrounding the lower Chesapeake Bay. A nearly linear trend of atmospheric particulate deposition was recorded. Deposition rates at the urban station (195 microg/sq m/day) were approximately three times greater than those recorded for nonurban and coastal locations (mean value 69 microg/sq m/day). The increased levels at the urban location were attributed to localized source inputs. Anthropogenic hydrocarbons accounted for approximately 50% of the total deposition at all stations. Significant biogenic inputs were indicated by the odd/even n-alkane distribution. A minimum flux to the water surface, based on mean nonurban deposition rates (24 mg/yr), indicated an annual particulate hydrocarbon flux of +275 metric tons. Little information is available for the comparison of additional source inputs; however, the data reported here indicate that the aerial deposition of hydrocarbons is of the same order of magnitude as the input from municipal wastewater facilities and accidental discharge and is a potentially signficant source of hydrocarbon pollution to the Chesapeake Bay Estuary. (Murphy-IVI)
W84-03544

TRACE METAL DISTRIBUTIONS IN SAINT JOHN HARBOUR SEDIMENTS,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, and S. D. MacKnight.
Marine Pollution Bulletin, Vol. 15, No. 1, p 12-18, January, 1984. 8 Fig, 4 Tab, 15 Ref.

Descriptors: *Trace metals, *Saint John Harbor, *Sediments, Sedimentation, Dredging, Estuaries, Distribution, New Brunswick, Canada, Anthropogenic input.

The Saint John River has the largest estuary in the Province of New Brunswick, Canada. Its harbor is extensively used during the whole year and requires regular maintenance dredging. The open-water disposal site for the dredged material is situated off Black Point. The concentration and areal distribution of selected trace metals (Cu, Zn, Pb, Cd, Mo, Ni, Mn and Hg) in surficial sediments of Saint John Harbor, were studied to determine the extent of anthropogenic input and to estimate the effects of dumping dredged material in the outer harbor. Hg and Cd are of special concern, since the disposal of dredge material containing these two elements is regulated under the Ocean Dumping Control Act. The concentrations of all metals are low: Cu 16, Zn 53, Pb 24, Cd 0.16, Mo 3, Ni 16, Mn 296 and Hg 0.04 microg/g. Hg and Cd levels in sediment are well below the permissible limits of 0.75 and 0.6 microg/g, respectively, set by the Ocean Dumping Control Act. The mean concentrations of trace elements are similar to the low mean values in the unpolluted Bay of Fundy. There is an overall decline in concentrations of metals in the sediments from the inner to the outer harbor. Comparison of the metal levels in the sediments from different areas within the harbor indicate that there is a detectable anthropogenic input in the Courtenay Bay area. Trace metal levels at the dumpsite are significantly lower than in the Courtenay Bay area, where the bulk of the dredged material originates. (Murphy-IVI)
W84-03545

SURFACE-WATER QUALITY IN THE CAMPBELL CREEK BASIN, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
T. P. Brabets, and L. A. Wittenberg.
USGS Water-Resources Investigations Report 83-4096, 1983. 28 p, 20 Fig, 12 Tab, 11 Ref.

Descriptors: *Urban hydrology, *Water quality, Urban runoff, Streamflow, *Alaska, Anchorage, Campbell Creek basin.

Four streams in the Campbell Creek Basin were sampled during different flow conditions for an 18-month period. North Fork Campbell and South Fork Campbell Creeks drain areas virtually undisturbed by man's activities. The other two streams, Little Campbell Creek and the main stem Campbell Creek, drain areas that have been urbanized. The water from South Fork Campbell and North Fork Campbell Creeks is of good quality and does not adversely affect the water quality of the main stem Campbell Creek. Little Campbell Creek, which has been affected by urbanization, impacts the water quality of Campbell Creek during low-land snowmelt periods when discharges from South Fork Campbell and North Fork Campbell Creeks are small. High concentrations of suspended sediment in Campbell Creek may be contributed by Little Campbell Creek. Fecal-coliform bacteria concentrations are highest at Little Campbell Creek and probably account for most of the high coliform concentrations at Campbell Creek. (USGS)
W84-03592

WATER QUALITY AND OTHER HYDROLOGIC DATA COLLECTED IN AND AROUND A SURFACE COAL MINE, CLAY AND VIGO COUNTIES, INDIANA, 1977-80,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03597

HYDROLOGY OF THE LITTLE ANDROSCOGGIN RIVER VALLEY AQUIFER, OXFORD COUNTY, MAINE,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03607

SOUTH JEFFERSON STREAM QUALITY ASSESSMENT PROGRAM,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
J. V. DePinto.
Report, Temporary State Commission on Tug Hill, Watertown, N.Y., November, 1977. 19 p, 1 Fig, 4 Tab, 2 Ref.

Descriptors: *Water quality, *Stream pollution, *Chemical analysis, *Stream profiles, *Water sampling, *Bacterial analysis, Stream biota, Watersheds, Large watersheds, Streamflow, Eutrophication, Nutrients, Land use, Acidity, Acid streams, Water temperature, Alkalinity, Dissolved oxygen, Biological oxygen demand, Dissolved solids, Suspended solids, Phosphorus, Coliforms, Ammonia, Nitrogen, Nitrates.

This program was designed to provide an educational experience for a group of supervised Jefferson County High School students and to obtain specific data which will allow relationships to be seen between the Lake Ontario eastern coastal zone and upland watersheds on Tug Hill. The program will also serve as a benchmark for future studies by providing information by which to gauge future water quality, and the information is available to local towns. The students performed both qualitative observation of some of the important streams and periodic quantitative analysis of stream water quality by laboratory testing of water samples collected at nine sites. The following parameters were tested: pH, alkalinity, temperature, dissolved oxygen, BOD5, suspended and dissolved solids, ammonia-nitrogen, nitrate-nitrogen, total phosphorus, and total coliform. Stream flow was estimated, too. The overall water quality of the South Jefferson County streams sampled in the study is good, and, discounting the presence of toxic substances, these streams should support a healthy, diverse aquatic community. In general, the downstream water quality appears to be slightly lower (increase in BOD5, solids, and total phosphorus). The nutrient loadings to Lake Ontario are such that the nearshore bays receiving these nutrients might eventually suffer the effects of eutrophication. The major land use impact on stream water quality appears to be the effect of the village of Adams on Sandy Creek. (Fazio-Omniplan)
W84-03654

ADDENDUM TO THE SURFACE WATER QUALITY REPORT,
Disko (M.) Associates, Union, NJ.
M. Disko, and T. Marturano.
Report, September 1981. 344 p, 73 Fig, 103 Tab.

Descriptors: *Surface water, *Surface-groundwater relations, *Computers, *Computer programs, *Water quality data, *Stream profiles, Stream discharge, Streams, Catchment areas, Wastewater disposal, Water quality, Dissolved solids, Data analysis.

The preliminary report in 1978 contained an analysis of only five of 21 parameters actually measured, because of a time constraint imposed by problems with the state's STORET computer system. Since there was not statistical analysis of the data available, the preliminary report contained only information pertaining to the percentage of time each station violated a state standard. Analyses in the report should not be correlated with results in the 1978 report because numerous data corrections as well as three months of additional testing changed the statistical averages. Instead of using STORET's analytical capabilities, a more flexible program, Statistical Analysis Systems, was used to analyze the data. Twelve of the fifty-seven stations have been designated as trout maintenance waters. There is an increase in the dissolved oxygen standard from five to six mg/l. Other standards at the time of the sampling were turbidity, pH, fecal coliform, total dissolved solids, and total phosphorus. Since Ocean County soils are naturally acidic, the average pH of the area is well below the 6.5 standard. The total dissolved solids standard for these water is 133 percent of the background value. The water quality in Crosswicks Creek was found to be one of the poorest in the county. Almost every parameter recorded its highest concentration at this station, sometimes several times larger than the county average. In general, it appears that poorer water quality is in the north and western parts of the county. (Garrison-Omniplan)
W84-03678

BIOACCUMULATION MONITORING IN THE NEW YORK BIGHT USING THE BLUE MUSSEL (MYTILUS EDULIS),
Army Engineer District, New York.
For primary bibliographic entry see Field 5C.
W84-03683

VARIABILITY OF SURFACE RECHARGE AND ITS EFFECTS ON GROUNDWATER IN SUFFOLK COUNTY, LONG ISLAND,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
W. H. Brutsaert, and T. S. Steenhuis.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154376, Price codes: A02 for paper copy, A01 for microfiche. Completion Report, September, 1983. 9 p, 4 Fig, 4 Ref. Project No. OWRT A-095-NY (1), Contract/Grant No. 14-34-0001-2134.

Descriptors: Groundwater pollution, Infiltration, Spatial variability, Unsaturated flow, Long Island, Porous media flow, Path of pollutants, *New York, Suffolk County, Groundwater recharge, Soil contamination.

The overall objective was to gain more insight in the variability of downward movement of water, which is the main carrier agent of pollutants in the soil. The study focused on Eastern Long Island where conditions of groundwater pollution are especially severe. For this purpose the infiltration properties of a Haven loam were determined in the laboratory by means of a newly-designed vertical capillary rise apparatus on 180 disturbed field samples of topsoil and subsoil. The experimental data were first processed by means of several concise formulations for sorption; measured and determined for each sample were rate of wetting front advance, three forms of sorptivity and four diffusivities. Subsequently a geostatistical analysis was performed and applied to the subsoil sorptivity data. The understanding gained in this project will be incorporated in predictive modeling techniques for the transport of toxic chemicals to the groundwater.
W84-03693

VIRUS MOVEMENT IN SOIL DURING SATURATED AND UNSATURATED FLOW,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance, and C. P. Gerba.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 335-337, February, 1984. 1 Fig, 3 Tab, 13 Ref. EPA project R-805,292.

Descriptors: *Viruses, *Soil water, *Saturated flow, *Unsaturated flow, Soil columns, Wastewater disposal, Water reuse, Poliovirus, Soil absorption capacity.

Virus movement in soils has received much attention because land application of wastewater offers a unique opportunity to turn the wastewater into a valuable water resource while minimizing the pollution of surface water. Virus movement in soil during saturated and unsaturated flow was compared by adding poliovirus to sewage water and applying the water at different rates to a 250-cm-long soil column equipped with ceramic samplers at different depths. Movement of viruses during unsaturated flow of sewage through soil columns was much less than during saturated flow. Viruses did not move below the 40-cm level when sewage water was applied at less than the maximum infiltration rate; virus penetration in columns flooded with sewage was at lease 160 cm. Therefore, virus movement in soils irrigated with sewage should be less than in flooded groundwater recharge basins or in saturated soil columns. Management of land treatment systems to provide unsaturated flow through the soil should minimize the depth of virus penetration. Differences in virus movement during saturated and unsaturated flow must be considered in the development of any model used to simulate virus movement in soils. (Murphy-IVI)
W84-03703

PENETRATION OF DIFFERENT HUMAN PATHOGENIC VIRUSES INTO SAND COLUMNS PERCOLATED WITH DISTILLED WATER, GROUNDWATER, OR WASTEWATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
H. Dizer, A. Nasser, and J. M. Lopez.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 409-415, February, 1984. 7 Fig, 22 Ref.

Descriptors: *Viruses, *Sand columns, *Percolating water, *Distilled water, *Groundwater, *Wastewater, Water reuse, Decontamination, Drinking water, Adsorption, Tertiary effluent, Groundwater recharge, Infiltration, Percolation rate.

Thanks to the adsorption processes in aquifers and to the metabolism of their microflora, groundwater, if contaminated, has the tendency to regenerate itself. This makes an underground recharge of tertiary treated wastewater an ideal last step before the wastewater is reused. The adsorption of several enteroviruses and rotavirus SA11 to sand from an aquifer in the Federal Republic of Germany was estimated in sand-filled columns loaded with ca. 107 PFU and run at a velocity of 2.5 m/day for 12 h. After either distilled water, groundwater, secondary effluent, or tertiary effluent was percolated, the sand core was slowly extruded out of the column and cut in 1-cm slices. The slices were eluted with nutrient broth, and the amount of viruses in the broth was estimated. The best adsorption was promoted by groundwater and tertiary effluent, followed by distilled water and secondary effluent. Similar experiments, carried out at different percolation rates, indicated that a 50-day

underground stay of recharged water probably suffices to eliminate viruses in the groundwater-recharged tertiary effluent. However, when viruses and sand were incubated in the presence of the surfactants sodium dodecyl sulfate, nonyl phenol, dodigen 226, or alkylbenzylsulfonate, the adsorption of the viruses was substantially diminished. Experiments in the presence of nonyl phenol seem to indicate that hydrophobic interactions are involved in the adsorption of viruses to sand. (Murphy-IVI)
W84-03704

DISTRIBUTION FUNCTION OF HEAVY METALS IN RIVER SEDIMENT,
Nippon Inst. of Tech., Saitama. Applied Statistics Lab.
H. Nishida, and M. Miyai.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 212-219, February, 1984. 2 Fig, 2 Tab, 5 Ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Sediments, Japan, Copper, Chromium, Zinc, Lead, Cadmium, Nickel, Distribution.

Random samples of unpolluted upstream and downstream sediments were obtained at 10 points from the right to left banks of each of 92 rivers in Japan. The upstream sediments were taken at unpolluted places and those downstream were taken about 1 km from the river mouth. The quantities of heavy metals soluble in hydrochloric acid were measured. In order to decide the distribution function of each heavy metal, its AIC was calculated. The AIC is a statistical decision procedure for model fitting. Each heavy metal of river sediment derived from a single source was found to be distributed lognormally. (Baker-IVI)
W84-03707

RESIDUES OF 4-CHLORO-1-(2,4-DICHLOROPHENOXY)-2-METHOXYBENZENE (TRICLOSAN METHYL) IN AQUATIC BIOTA,
Tokyo Metropolitan Research Lab. of Public Health (Japan).
T. Miyazaki, T. Yamagishi, and M. Matsumoto.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 227-232, February, 1984. 3 Fig, 3 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Fish, *Organic compounds, Triclosan methyl, Fish, Oysters, Clams, Mussels, Tama River, Tokyo Bay, Japan.

A total of 14 samples (10 fish and four shellfish) was collected at 11 sampling locations in the Tama River and Tokyo Bay (Japan) during September to October 1981. Triclosan methyl was found in 13 of the 14 samples, detected in all freshwater fish, and ranged from 1-38 ppb. Triclosan methyl is a methyl ether deriviative of triclosan, a broad spectrum antibacterial agent used widely in varied products such as deodorant, surgical scrub preparations, and medicated cosmetics. The concentrations in the fish samples increased downstream. Triclosan methyl residue was also found in shellfish taken from Keihinjima along Tokyo Bay with short necked clams having 3 ppb; thin shelled surf clams, 13 ppb; oysters, 13 ppb and blue mussel, 20 ppb. (Baker-IVI)
W84-03709

COOLING WATER SUPPLY DISPOSAL IN COASTAL AQUIFER,
Dames and Moore, Honolulu, HI.
M. R. Fujioka, and A. K. Runchal.
Journal of Energy Engineering (ASCE), Vol. 109, No. 2, p 88-102, June, 1983. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Cooling water, *Disposal wells, *Coastal aquifer, Coupled fluid flow, Heat transport, Mass transport, Groundwater, Water reuse, Mathematical models, Geohydrology, Permeability coefficient.

The analysis of cooling water supply and thermal effluent disposal within a coastal aquifer requires the solution of the coupled transport equations for groundwater, heat, and mass transfer. A general numerical model for these requirements was applied to assess feasibility of simultaneous cooling water supply and effluent disposal by wells. Hydraulic conductivities were calibrated using groundwater heads and flux data. Existing conditions, a Ghyben-Herzberg lens in dynamic equilibrium, were modeled, and served as initial conditions for subsequent analysis. Various injection and supply well configurations were modeled and feasible configurations were identified. A number of conclusions were developed regarding flow velocities, cross-circulation flow, hydraulic interchange with the adjacent ocean, heat removal mechanisms, effects on the fresh water lens, and ocean bottom heating. (Murphy-IVI)
W84-03713

STUDY OF THE POLLUTION POTENTIAL OF LAND-SPREAD SEPTAGE,
Oregon State Univ. Extension Service, Corvallis.
J. A. Moore, and G.R. Beehler.
Journal of Environmental Health, Vol. 46, No. 4, p 171-175, January/February, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Land disposal, *Groundwater pollution, *Septage, Nitrates, Coliforms, Soil properties, Hydraulic loading.

There are two possible health hazards associated with the land spreading of septage: pathogenic and chemical contamination of surface and groundwaters. Seven plots which had not previously been treated with septage were treated with two types of domestic septage application. Four plots, receiving no more than 3,000 gal/day were intermittently loaded receiving 174,000, 169,000, 32,000 and 39,000 gallons of septage during the three year study. This represented a total nitrogen application equivalent to 2,400, 1,100, 630 and 290 lbs N/acre. Spreading nitrogen at a rate of 10,000 lbs/acre or 90 acre inch of septage over an 11 week period resulted in no evidence of penetration of fecal coliform organisms to the shallow (3 m) water table. The nitrate nitrogen increased slightly in one of the four monitoring wells, and all values were below 10 mg/l. Neither slug loading up to 4 gal/sq foot or steady intermittent loadings (up to 3,000 gal per plot/day) of septage harmed the shallow groundwater. Fecal coliform counts and nitrate nitrogen levels show the tremendous treatment capability of the sandy soil. Finer textured soils should provide a better filter and further reduce the movement of organisms and nitrate. The capacity of the soil filter can be exceeded, resulting in contamination of the groundwater. Application rate of septage should be limited depending on the characteristics of the receiver soil, so that hydraulic loading would provide unsaturated flow through the profile, allowing adequate treatment. (Baker-IVI)
W84-03722

VIRUSES IN GROUNDWATER BENEATH SEWAGE IRRIGATED CROPLAND,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
S. M. Goyal, B. H. Keswick, and C. P. Gerba.
Water Research, Vol. 18, No. 3, p 299-302, 1984. 6 Tab, 14 Ref.

Descriptors: *Viruses, *Wastewater irrigation, *Groundwater pollution, Wells, Spray irrigation, Land disposal, Wastewater disposal, Irrigation, Coliforms, Coxsackievirus, Water reuse, Chlorination.

The occurrence of enteric viruses in groundwater and soil was examined beneath three different sites where slow rate sewage irrigation of cropland is practiced. One site was in Lubbock, Texas where a sewage treatment plant supplies 57,000 cu m/day of secondarily treated effluent to a privately owned 3000 acre farm where the effluent is applied by flood or spray irrigation. Location two was in San Angelo, Texas where secondarily treated effluent is applied to a 640 acre farm by flood irrigation. Location three was in Muskegon, Michigan, where sewage at a rate of 105,000 cu m/day is aerated and stored in two 850 acre lagoons. The effluent is then applied to the 11,000 acre farm by 54 center-pivot spray arms at rates of up to 10 cm per week. Enteric viruses were isolated from wells beneath all sites. The lowest frequency of isolation was from wells beneath the one site practicing chlorination before application by spray irrigation. Viruses were detected in wells as deep as 27.5 m. (Baker-IVI)
W84-03731

STUDIES ON VINYL CHLORIDE MIGRATING INTO DRINKING WATER FROM POLYVINYL CHLORIDE PIPE AND REACTION BETWEEN VINYL CHLORIDE AND CHLORINE,
National Inst. of Hygienic Sciences, Tokyo (Japan).
M. Ando, and Y. Sayato.
Water Research, Vol. 18, No. 3, p 315-318, 1984. 9 Fig, 1 Tab, 6 Ref.

Descriptors: *Water pollution sources, *Vinyl chloride, *Pipes, *Drinking water, *Polyvinyl chloride, Pipe liners, Migration, Chemical reactions, Chlorine, Chloroacetaldehyde, Chloroacetic acid, Hydrogen ion concentration, Water conveyance.

Actual conditions under which vinyl chloride monomer (VCM) migrates into water from polyvinyl chloride (PVC) pipes and the reaction of VCM with chlorine in water are considered. In one study method, migration of VCM into water from PVC pipes was examined by sealing water in sections of PVC pipe. In the second method a few pieces of PVC pipe were sealed with water in a serum vial. Migration of VCM into water from PVC pipes could only be detected by using an apparatus that prevented volatilization of VCM and increased the surface area of the pipe wall in contact with the water. The amount of VCM which could undergo action of the chlorine in the water decreased markedly with the age of the pipes and when the pH was lowered. VCM occurred in the water and was converted to chloroacetaldehyde, chloroacetic acid and other compounds through its reaction with chlorine. The amounts of these reactants varied with the pH of the solution. (Baker-IVI)
W84-03733

HEAVY METALS IN THE SURFICIAL SEDIMENTS OF FONTANA LAKE, NORTH CAROLINA,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
A. R. Abernathy, G. L. Larson, and R. C. Mathews, Jr.
Water Research, Vol. 18, No. 3, p 351-354, 1984. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Heavy metals, *Lake sediments, *Fontana Lake, *North Carolina, Lakes, Sediments, Zinc, Copper, Mercury, Aluminum, Manganese, Iron, Magnesium, Minerals.

Samples of sediment were collected in the main body of Fontana Lake and near the mouths of its major tributaries. Analyses were conducted for magnesium, iron, aluminum, manganese, zinc, copper, and mercury. While the drainage area of the reservoir is primarily forested and rural without major industrial developments, manganese, copper and zinc were present in concentrations similar to areas receiving industrial pollution. Chemical analyses of pyritic materials in the watershed showed relatively high concentrations of many of the same metals. Therefore, inputs of metal compounds may be expected from lake or reservoir drainage basins with mineralized deposits. Accumulations of these metals in the sediments may pose a biological risk in the future. This may be especially important should the lake or reservoir acidity increase owing to impacts from acid precipitation upon the soft water system. (Baker-IVI)
W84-03738

CONTAMINATION OF AN UNCONFINED SAND AQUIFER BY WASTE PULP LIQUOR: A CASE STUDY,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
W. D. Robertson, J. F. Barker, Y. LeBeau, and S. Marcoux.
Ground Water, Vol. 22, No. 2, p 191-197, March-April, 1984. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Groundwater pollution, *Unconfined aquifers, Aquifers, Path of pollutants, Pulp and paper industry, Industrial wastes, Waste disposal, Sulfates, Chlorides, Sodium, Plumes, Lignin, Tannin.

A zone of contaminated groundwater has been identified in an unconfined sand aquifer adjacent to a pit near the town of La Tuque, Quebec into which spent pulp liquor was intermittently discharged from 1970 to 1979. The installation of multilevel piezometers has provided a cost-effective method for three-dimensional mapping and sampling of the plume in the sand. The contaminated groundwater is characterized by elevated concentrations of Na (3,000 mg/l), Cl (590 mg/l), alkalinity (2,700 mg/l), total organic carbon (2,000 mg/l), COD (10,800 mg/l), BOD (2,000 mg/l) tannin and lignin (780 mg/l), and lower sulfate (1 mg/l) compared to groundwater in the area. Contaminants such as Na(+), Cl(-), tannin and lignin appear to migrate at a rate close to the average linear groundwater velocity. Hydrodynamic dispersion has caused vertical and horizontal spreading of the contaminants and significant dilution especially near the leading edge of the plume. Other major contaminants such as sulfates and high pH are substantially attenuated, probably in part by microbially mediated processes. Some organic components also appear to be attenuated, but high concentrations of less biodegradable substances such as tannin and lignin, persist along the flow path. (Baker-IVI)
W84-03763

FATE AND EFFECT OF (14C)FENVALERATE IN A TIDAL MARSH SEDIMENT ECOSYSTEM MODEL,
Maryland Univ., College Park. Dept. of Entomology.
J. A. Caplan, A. R. Isensee, and J. O. Nelson.
Journal of Agricultural and Food Chemistry, Vol. 23, No. 1, p 166-171, January/February, 1984. 7 Fig, 3 Tab, 17 Ref.

Descriptors: *Pesticides, *Fenvalerate, *Tidal marshes, Fate of pollutants, Sediments, Leaching, Microorganisms, Water pollution effects, Salt marshes.

A model salt marsh ecosystem was developed and used to evaluate the fate and effect of a pesticide under simulated salt marsh conditions. Fenvalerate was used as a reference pesticide. Fenvalerate is a pyrethroid insecticide that has great potential for control of a wide range of insect pests in agriculture. Two dosages (0.2 and 1.0 ppm) of C-14 labeled fenvalerate were uniformly applied to the sediment. Additionally, a third treatment (1.0 ppm) was applied to the top centimeter of a 3-cm column to monitor the vertical movement of the compound (plus metabolites). No adverse effects of C-14 fenvalerate on heterotrophic microorganisms were observed after 7 days at any treatment level, as measured by plate counts and substrate degradation assays (starch, cellulose, and protein). The half-lives of C-14 fenvalerate in the 0.2- and 1.0 ppm noncolumn treatments were 6.3 and 8.9 days, respectively. The lower half-life (3.2 days) observed in the 1.0 ppm column treatment was attributed to a higher leaching rate in that treatment. TLC analysis of sediment extracts revealed the presence of three identifiable metabolites in all treatments after 4 days of incubation. (Baker-IVI)
W84-03769

ORIGINS OF SOME ARSENIFEROUS GROUNDWATERS IN NOVA SCOTIA AND NEW BRUNSWICK, CANADA,
National Hydrology Research Inst., Ottawa (Ontario).
D. J. Bottomley.
Journal of Hydrology, Vol. 69, No. 1-4, p 223-257, February, 1984. 16 Fig, 5 Tab, 70 Ref.

Descriptors: *Arsenic, *Groundwater, *Nova Scotia, *New Brunswick, Groundwater pollution, Mine wastes, Gold, Ferric oxyhydroxides, Hydrogeology, Chemical properties, Geochemistry.

The presence of arsenic in drinking-water supplies is a cause for concern since its potential toxicity, mutagenicity and carcinogenicity to man is still poorly understood and very controversial. Arsenic is relatively mobile under a broad range of pH-Eh conditions typical of groundwaters with the result that where arseniferous minerals are present in the subsurface, aresenic contamination of groundwaters has frequently be reported. Arsenic-contaminated groundwaters occur in regions of New Brunswick underlain by the Carboniferous volcanic tuff of the Harvey Formation, and in Nova Scotia where bedrock is comprised of early Paleozoic metasedimentary formations of the Meguma Group. At Harvey, N.B., aresenic is present in dispersed iron oxide aggregations in the tuff, whereas in the Meguma rocks arsenic is concentrated in arsenopyrite commonly present in quartz veins that were once mined for their gold content. The arsenic-contaminated groundwaters range in age from less than 10 yr. to greater than 100,000 yr. and are found both under oxidizing and reducing conditions. While the arsenic contamination in both areas is ultimately attributable to oxidation of arseniferous minerals, geochemical analyses of the aquifer materials in a former gold mining district of Nova Scotia suggest contamination of young groundwater may occur through exchange reactions with 'unsupported' extractable arsenic associated with ferric oxyhydroxides. The source of this extractable arsenic was likely infiltrated runoff that had been in contact with mine waste rock. (Murphy-IVI)
W84-03785

RESIDENCE TIME: APPLICATION TO SMALL BOAT BASINS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. van de Kreeke.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 4, p 416-428, November, 1983. 4 Fig, 5 Ref.

Descriptors: *Residence time, *Boat basins, Water pollution, Marine environment, Recreation wastes, Boating, Marinas, Water circulation, Mathematical equations, Tidal hydraulics.

To assure that concentrations of pollutants remain below critical levels, the pollutant input has to be small and the rate at which the water in the boat basin is exchanged has to be large. Using a continuous exchange model, analytical expressions for the transit time distribution function and the age distribution function are derived for a basin having a constant volume. The residence time for instantaneous as well as continuous dye injections equals the volume of the basin divided by the rate at which new water is added to the basin. Using the tidal prism model it is shown that the normalized residence time for an instantaneous dye injection is a function of three dimensionless parameters. These parameters are: (1) The average basin volume divided by the volume of new water returning on the flood; (2) the fraction of the flood volume (= tidal prism) that is new water; and (3) the phase of the tide at which the dye is injected. For a continuous dye injection, the normalized residence time is a function of the first two parameters only. Numerical computations show that, to a first approximation, the residence times equal the average basin volume divided by the volume of new water entering during flood with secondary effects introduced by the other parameters. (Murphy-IVI)
W84-03798

CONSERVATIVE BEHAVIOUR OF BORON IN THE TAMAR ESTUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-03806

LANDFILL LEACHATE MIGRATION THROUGH SHALLOW UNCONFINED AQUIFERS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. W. Ostendorf, R. R. Noss, and D. O. Lederer.
Water Resources Research, Vol. 20, No. 2, p 291-296, February, 1984. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Landfills, *Leachates, *Aquifers, Model studies, Transport, Groundwater pollution, Water pollution sources, Kinetics, Adsorption.

The transport of a simple reactive contaminant through a landfill and an initially pure, underlying shallow, one-dimensional unconfined aquifer has been modeled. The aquifer has a plane, sloping bottom with steady hydraulic conditions. Absence of dispersion and downgradient dilution were assumed. The user population and a presumedly constant contaminant loading factor determine the pollution input to the groundwater system. The near field response is modeled as a single linear reservoir whose output comprises the far field source term at the downgradient edge of the landfill. The far field analysis yields a method of characteristics solution valid in the vicinity of the source location with frame speeds modified by recharge, head loss, bottom slope, and linear adsorption, and concentrations reflecting first order reaction kinetics. The near and far field models are calibrated and tested against conservative chloride and first order reactive bicarbonate data at the Babylon, New York landfill with accurate and physically plausible results. (Baker-IVI)
W84-03825

SOLUTE REDISTRIBUTION DURING NORMAL FREEZING,
Iowa Univ., Iowa City.
W. K. S. Leung, and G. R. Carmichael.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 141-150, January, 1984. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Model studies, *Freezing, *Solutes, Mathematical models, Burton-Slichter film theory, Films, Snowmelt, Ice.

In northern areas where snow precipitation is abundant in winter time, 50 to 80% of the pollutants accumulated in the snowpack are released when the first 30% melts. The very first meltwater may have concentrations 5 times the values found in the bulk. A thorough understanding of snow and ice pack chemistry and melting is necessary to predict the chemical composition and delivery rates of meltwater aquatic systems. An investigation of segregation of solutes and their transport properties in ice layers is reported and techniques for estimating solute redistribution resulting from normal freezing processes are presented. Mathematical models used in metallurgy to describe solute partitioning are applied to solute distribution in ice crystals. The method can be used to estimate distribution coefficients from experimental data. Under the assumptions of this model the solute concentration in the solid is linearly dependent on the solute concentration in the liquid and the distribution coefficient is concentration independent and constant. However, predicted distribution coefficients varied with the fraction frozen. The deviation of experimental results from normal freezing theory is consistent with the Burton-Slichter film theory model. (Baker-IVI)
W84-03831

SULPHATE AND NITRATE RELATED TO ACIDITY IN RAINWATER,
Central Energy Generating Board, Ratcliffe-on-Soar (England). Scientific Services Dept.
A. Martin.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 271-277, January, 1984.

Descriptors: *Acid rain, *Sulfates, *Nitrates, Water pollution sources, Monitoring, Acidity, Sampling, Europe, Hydrogen ion concentration.

Sulfate and nitrate concentrations in rainwater were shown to vary systematically with the acidi-

ties of the samples from certain rural sites from Europe and the U.S. Major differences were found between strong- and weakly-acid rainwaters. The mean non-sea sulfate to H(+) ratios in the weakest acid class correlate significantly with the annual SO2 in air for the 8 sites in Europe whereas those in the strongest acid class do not. The mean ratios of nitrate to H(+) show a similar pattern to the ratios of sulfate to H(+), but the weakly acid values are only about 0.33 as large. Weakly acid samples could modify on standing and therefore special care is needed in attempts to use them to identify sources. Some differences are noted between samples from Europe and from the Northeastern United States, possible due to the differences in the types of collectors used. In terms of possible effects, rainwater sampled by open collectors for the period over which effects may develop, and modifying as they will, might be an adequate simulation of rain on some types of surfaces. Only strong acid cloud and rainwaters, sampled as events (or daily) in ways that minimize changes in the solutions, are likely to be relevant to their initial composition. Weak acid samples, or mixtures of strong and weak acid samples, should only be used for that purpose with the utmost care. (Baker-IVI)
W84-03835

MOVEMENT OF PHORATE UNDER CONSTANT AND VARIABLE SURFACE WATER FLUX IN INITIALLY DRY AND MOIST SOILS,
Haryana Agricultural Univ., Hissar (India). Dept. of Entomology.
G. Singh, I. S. Dahiya, and Z. Singh.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 439-446, January, 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Insecticides, *Leaching, Phorate, Organic compounds, Soil properties, Soil water, Surface water.

Agricultural chemicals applied to the soil surface are susceptible to transport through the soil profile with the flowing soil water when water infiltration occurs as a consequence of rainfall or irrigation. The distribution of phorate was studied in three texturally different soils under constant and variable surface flux of water. Phorate distribution profiles and leaching curves showed that the insecticide was displaced more efficiently and its concentration peak formed at deeper depth with constant than with variable water flux in sandy loam soils irrespective of initial soil water content. Phorate distribution profiles, however, were independent of the methods of water application in clay soil because of its extremely low permeability. Phorate distribution was considerably dependent on the initial soil water content. The greater the initial soil water content, the greater was the penetration of phorate. (Baker-IVI)
W84-03841

DISSOLVED NITROGEN SUPERSATURATION OF A HEATED EFFLUENT,
Delaware Univ., Newark. School of Life and Health Sciences.
D. A. Neumann, E. L. Melisky, and W. J. Wachter, Jr.
Water, Air, and Soil Pollution, Vol. 22, No. 1-4, p 1-13, January, 1984. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Dissolved nitrogen, *Supersaturation, *Heated water, *Effluents, Electric powerplants, Nitrogen, Water pollution effects, Cooling water, Water temperature, Thermal pollution, Fishkill, Erie, Pennsylvania.

Electric power generation constitutes one of the largest industrial uses of water in the United States. Presented is an empirical assessment of the dynamics of dissolved gas supersaturation in the effluent of a steam electric generating station in response to observations of mass mortalities among fish overwintering in a heated effluent. Surface water samples were collected from the intake, discharge, and heated plume of a fossil-fueled electric generating station from January 1974 through September 1976. Dissolved N2 concentrations were determined manometrically for each sample and the percent saturation of each was calculated. Intake N2 levels were near saturation throughout the sampling period while discharge N2 values consistently exceeded saturation, often ranging from 110% to 120% saturation. Saturation levels based on N2 analysis and on polarographic measurement O2 did not differ significantly. Discharge saturation levels were predictable from a three variable equation which considered the rise in cooling water temperature (delta T), percent N2 saturation at the intake, and cooling water flow rate. Other parameters associated with cooling system operation were not significantly related to the discharge N2 level. First-order regression analysis indicated that discharge saturation levels could be readily estimated from delta T measurements. Seasonal variation in supersaturation levels at the discharge was related to the interaction of the delta T and the intake temperature. Supersaturation occurred throughout the heated effluent; levels decreased with increasing distance from the discharge. Dissipation of supersaturated conditions in the plume resulted from cooling and was predictable. (Murphy-IVI)
W84-03842

BULK DEPOSITION OF METALS IN TULSA, OKLAHOMA,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
M. B. Tata, and M. H. Bates.
Water, Air, and Soil Pollution, Vol. 22, No. 1, p 15-26, January, 1984. 6 Fig, 3 Tab, 27 Ref.

Descriptors: *Metals, *Deposition, *Arkansas River, *Tulsa, *Oklahoma, *Precipitation, Cadmium, Chromium, Lead, Nickel, Zinc, Heavy metals, Water pollution sources.

A low water dam is being constructed on the Arkansas river near downtown Tulsa, Oklahoma and it is feared that the quiescent pool which will be formed could be a sink for toxic heavy metals. Samples of bulk precipitation (wet and dry fallout) were collected at six sites adjacent to the Arkansas River in Tulsa over an 11 month period and analyzed by flameless atomic absorbtion spectrophotometry for cadmium, nickel, chromium, lead, and zinc. Metal deposition was fairly constant from site to site and appeared to be proportional to the amount of precipitation collected. Zinc was by far the largest contributing metal at 497 mg/sq m/yr, followed by Pb, Cr, Ni and Cd at 25.5, 25.7, 7.02, and 0.95 mg/sq m/yr, respectively. Concentration data vaired greatly over the collection period. The average volume-weighted concentrations in micrograms per liter were CD-2.1, Cr-57.0, Ni-15.6, Pb-56.6, and Zn-1100. (Baker-IVI)
W84-03843

BENZ(A)PYRENE INPUT AND OCCURRENCE IN A MARINE AREA AFFECTED BY REFINERY EFFLUENT,
Marine Pollution Lab., Charlottenlund (Denmark).
K. Jensen.
Water, Air, and Soil Pollution, Vol. 22, No. 1, January, 1984. 3 Fig, 5 Tab, 10 Ref.

Descriptors: *Organic compounds, *Benz(a)pyrene, *Kalundborg Fjord, *Denmark, Oil wastes, Industrial wastes, Water pollution sources, Sediments, Degradation, Advection, Fate of pollutants.

The load of benz(a)pyrene (BaP) in Kalundborg Fjord, a marine coastal area in the vicinity of a town and an oil refinery was estimated. An oil refinery discharges 1,500,000 cu m/yr of wastewater into the inlet. The levels of the compound in refinery effluent, municipal wastewater, urban run-off, rivers, and atmospheric fall-out have been determined. Three major routes are assumed to account for the removal of BaP from the water body of Kalundborg Fjord. These include degeneration in the water, sedimentation and advective water exchange. The major problem to estimating the removal of BaP from the water body is to estimate the standing stock of BaP. The degradation rate is very slow. At one station in the fjord the sedimentation rate of dry matter has been determined at 740 g/sq m/yr. If the BaP content of the sedimentated materials equals the level in the surface sediment at this particular station, 41 micro g/kg, the sedimentation would be 30.3 micro g/sq m/yr. The remaining part of BaP, approximately 1 kg, is removed by advective water transport. (Baker-IVI)
W84-03844

BACTERIAL POLLUTION OF GROUNDWATER: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
S. R. Crane, and J. A. Moore.
Water, Air, and Soil Pollution, Vol. 22, No. 1, p 67-83, January, 1984. 2 Fig, 4 Tab, 83 Ref.

Descriptors: *Bacteria, *Groundwater pollution, Wastewater Disposal, Wastewater pollution, Reviews, Soil contamination, Soil classification, Soil physical properties, Soil water, Wastewater management, Infiltration.

Contamination of groundwater resources from bacterial laden wastewater and effluents poses a great threat to potability and use of these water sources. Future planning, development and management schemes must consider this topic to avoid costly and sometimes untested corrective actions. Major factors affecting the quantity and velocity at which bacteria are able to migrate through soil can be classified as (1) soil factors including particle size distribution, structure, clay content, pore size distribution and moisture regime, and (2) biological factors responsible for bacterial die-off including pH, temperature, moisture content, and nutrient supply. Past bacterial pollution problems have been shown to be localized and restricted to wells utilizing near-surface waters. The following problem areas exist and must be given special consideration in planning and development: (1) use of septic disposal systems in unsuitable soils; (2) drainage water from wastewater application areas utilizing artificial drainage systems; (3) waste application in areas underlain by fractured crystalline rock or channelized bedrock; and (4) bacterial contamination induced over great distances by groundwater pumping. (Author's abstract)
W84-03845

WATER QUALITY AT AND ADJACENT TO THE SOUTH DADE COUNTY SOLID-WASTE DISPOSAL FACILITY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
D. J. McKenzie.
Available from the Ofss, USGS, Lakewood, CO 80225; Price: $5.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 83-4003, 1983. 37 p, 8 Fig, 8 Tab, 23 Ref.

Descriptors: *Water quality, Landfill, Leachate, *Limestone aquifer, Organic decomposition, Solid waste, *Biscayne aquifer, Biscayne Bay, *Florida, *Nitrification, Chloride indicator, Ammonia tracer, Ammonia migration, Alkalinity.

A water-quality reconnaissance was conducted at the south Dade County solid-waste landfill near Goulds, Florida, from December 1977 through August 1978. The landfill is located directly on the unconfined Biscayne aquifer, which, in the study area, is affected by saltwater intrusion. Water samples collected from six monitor well sites at two depths and four surface-water sites were analyzed to determine the chemical, physical, and biological conditions of the ground water and surface water of the study area. Results indicated that water quality beneath the landfill was highly variable with location and depth. Leachate was generally more evident in the shallow wells and during the dry-season sampling, but was greatly diluted and dispersed in the deep wells and during the wet season. High concentrations of contaminants were generated primarily in areas of the landfill with the most recent waste deposits. Chloride (limited to the shallow wells and the dry season), alkalinity, ammonia, iron, manganese, lead, phosphorus, and organic nitrogen indicate leachate contamination of the aquifer. Water-quality characteristics in the

surface waters were generally only slightly above background levels. (USGS)
W84-03846

HYDROLOGIC INFORMATION FOR LAND-USE PLANNING, BADGER ROAD AREA, FAIRBANKS, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
A. P. Krumhardt.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $2.25 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 82-4087, 1982. 14 p, 5 Fig, 3 Tab, 8 Ref.

Descriptors: Public health, Arsenic, Nitrate, Iron, Hardness, Water table, Groundwater movement, Water-level fluctuations, Fairbanks, *Alaska, Groundwater, Water wells, Water quality, Water levels.

The relatively flat Badger Road area near Fairbanks occupies part of the alluvial plain of the Chena and Tanana Rivers and is underlain by scattered areas of permafrost. The water table of the high-transmissivity aquifer that underlies the area is generally shallower than 15 feet, fluctuates seasonally about 2 feet, and slopes northwesterly, the direction of ground-water flow. Private domestic-supply wells obtain water from the upper part of the aquifer. Septic systems used to dispose of waste water are installed at or only slightly above the water table in the same aquifer. Analyses of samples from 16 observation wells in undeveloped parts of the study area and from 33 domestic wells indicated that water quality has not been significantly degraded by on-site waste disposal. Three samples had detectable but minor contamination by fecal coliform bacteria. Anomalous values of chloride and ammonia in one third of the domestic wells may indicate incipient degradation of ground-water quality by septic-tank effluent. (USGS)
W84-03852

POTENTIAL EFFECTS OF SURFACE COAL MINING ON THE HYDROLOGY OF THE GREENLEAF-MILLER AREA, ASHLAND, COAL FIELD, SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-03853

GROUND-WATER CONTAMINATION AT WURTSMITH AIR FORCE BASE, MICHIGAN,
Geological Survey, Lansing, MI. Water Resources Div.
J. R. Stark, T. R. Cummings, and F. R. Twenter.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $16.50 in paper copy, $4.00 in microfiche. USGS Water-Resources Investigations Report 82-4002, 1983. 93 p, 44 Fig, 4 Tab, 22 Ref.

Descriptors: *Hydrogeology, *Glacial drift, *Groundwater, Aquifers, Water supply, Groundwater movement, Water pollution, *Path of pollutants, Organic compounds, Wurtsmith Air Force Base, Iosco County, *Michigan.

A sand and gravel aquifer about 65 feet thick underlies Wurtsmith Air Force Base in northeastern lower Michigan. The water table ranges in depth from 10 feet to 25 feet below land surface. Mathematical models indicate that ground-water flow ranges from 0.8 feet per day in the eastern part of the Base to 0.3 feet per day in the western part. Trichlorethylene leaked from a buried storage tank in the southeastern part of the Base and moved northeastward in a plume, contaminating Base water-supply wells. Concentrations exceed 1,000 micrograms per liter in the most highly contaminated part of the plume. Purge pumping removed some of the trichloroethylene and seems to have arrested its eastward movement. Pumping of additional purge wells could increase the rate of removal. (USGS)
W84-03859

FATE AND EFFECTS OF ATRAZINE IN SMALL AQUATIC MICROCOSMS,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5C.
W84-03878

POLLUTION STUDIES ON NIGERIAN RIVERS: THE ONSET OF LEAD POLLUTION OF SURFACE WATERS IN IBADAN,
Ibadan Univ. (Nigeria). Dept. of Chemistry.
C. Mombeshora, O. Osibanjo, and S. O. Ajayi.
Environment International, Vol. 9, No. 2, p 81-84, 1983. 4 Tab, 7 Ref.

Descriptors: *Nigeria, *Ibadan, *Lead, Water pollution, Agodi Lake, Oba Lake, Ogunpa Stream, Ona River, Lake of the International Institute of Tropical Agriculture, Traffic density.

Lead levels in the waters and sediments of the lake of the International Institute of Tropical Agriculture, Agodi Lake, Oba Lake, at three stations on Ogunpa stream, and at three stations on Ona River were measured from October 1977 to June 1978, using the combined APDC-MIBK-flame atomic absorption spectrophotometry technique. The lead levels recorded ranged from 0.2 to 46 microg/L for the aqueous phases; however, the levels in the sediments were much higher, ranging from about 18 to 85 mg/kg (dry weights). Although there is nothing alarming about these levels, the levels of lead in water bodies located in areas with high traffic density were consistently higher than levels for comparable waters in low traffic density areas. Similarly, lead levels were significantly higher in the fresh sediments of water bodies in areas with high traffic density, clearly indicating the onset of lead pollution for those high traffic density areas. (Author's abstract)
W84-03886

OIL POLLUTION STUDIES IN THE NILE RIVER. 1. SURVEY OF OIL AND GREASE IN NILE WATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
A. S. Moursy.
Environment International, Vol. 9, No. 2, p 107-111, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Oil pollution, *Ships, *Nile River, *Egypt, Seasonal variations, Vaporization, Water quality control, Water analysis, Powerplants, Lake Nasser, Harbors.

A survey of oil and grease along the Nile River indicated the presence of variable concentrations of these pollutants. Five segments were identified along the Nile River: the Aswan, Assiut, Cairo, Demietta and Rossetta segments. Some stations along the Nile are more polluted than others. These are located mostly at Lake Nasser Port (Aswan segment); oil distribution centers and ship waiting areas (Assiut segment); boat docks, a ship yard, and an electric power station (Cairo segment); and at factory areas (Rossetta segment). The level of oil and grease decreased significantly when moving downstream. The dilution effects result in a lower level of the pollutants in these waters. Furthermore, various chemical, physical, and biological processes that are known to degrade or destroy oil in water undoubtedly contributed to the general decrease in the pollutant concentrations observed. The level of oil and grease along the river was also lower in summer than in winter and spring which may be attributed to the decrease of activities and increase of vaporization processes. (Baker-IVI)
W84-03888

ASSESSMENT OF EL-SALAAM UNDERGROUND WATER FOR POULTRY USE,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
H. T. El-Zanfaly, M. R. Lasheen, M. M. El-Abagy, S. A. El-Hawaary, and M. I. Badawy.
Environment International, Vol. 9, No. 4, p 313-317, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Water quality, *Bacteria, *Groundwater, *Egypt, El-Salaam, Wells, Water pollution sources, Fecal coliforms, Acidity, Sulfates, Alkalinity, Coliforms, Pesticides.

Water quality was investigated in 13 wells in El-Salaam, near Cairo. The wells were dug specifically to provide water for a company specializing in broiler poultry production. The water was analyzed for the following bacteriological parameters: total bacterial counts, total coliforms, fecal coliforms, fecal streptococci, aerobic spore formers, and total counts for Clostridium per 100 mL. Chemical parameters such as pH, sulfate, alkalinity, hardness, and pesticides indicate that the water is unacceptable for poultry production. Bacteriological testing revealed the same conclusion. Wastewater in an open drain is entering the groundwater. This wastewater contains tremendous concentrations of untreated discharges and represents a significant source of water pollution. (Baker-IVI)
W84-03893

INTERACTIONS BETWEEN DISSOLVED AND SOLID METAL SPECIES IN INLAND WATERS (WECHSELWIRKUNGEN ZWISCHEN GELOSTEN UND FESTEN METALLSPEZIES IN BINNENGEWASSERN),
Technische Univ., Hamburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
U. Forstner.
Fresenius Zeitschrift fur Analytische Chemie, No. 3-4, p 359-360, 1984. 20 Ref.

Descriptors: *Heavy metals, *Inland waters, Hydrologic properties, Chemical properties, Hydrologic cycle, Sediments, Particle size.

Intense industrialization in the Federal Republic of Germany has led to high concentrations of metals. In particular toxic levels of Hg is of high concern. Heavy metal interactions don't always form agglomerations in water but in the case where there is intense quantities of heavy metals a situation can occur where these metals coalesce. Heavy metal sorption reactions on mineral substrates like FeOOH, SiO2 or Al2O3 have sorption in water with 1-1.5 pH from 0 to 100%. The combination of heavy metals and extensive high pH in fresh water increases the potential for agglomeration of the heavy metals with sediment load. Particle size also dictates the potential for mineralization. (Murphy-IVI)
W84-03902

STUDIES ON SEDIMENTS OF THE UPPER AREA OF THE RIVER LAHN: DETERMINATION OF MERCURY AND EVALUATION OF THE RESULTS BY FACTOR ANALYSIS, (UNTERSUCHUNGEN AN SEDIMENTEN AUS DEM BEREICH DER OBEREN LAHN: QUECKSILBER-BESTIMMUNG UND FAKTORENANALYTISCHE AUSWERTUNG),
Marburg Univ. (Germany, F.R.). Fachbereich Chemie.
W. Spickermann, and G. Stork.
Fresenius Zeitschrift fur Analytische Chemie, Vol. 317, No. 3-4, p 361-365, 1984. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Sediments, *Mercury, Factor analysis, Ion exchange, Lahn River, Marburg, Federal Republic of Germany, Organic compounds.

A study was made on the mercury contents of sediments from the river Lahn and three tributary rivers in the area of Marburg. The contents of carbon and the weight percentage of the grain size fraction < 63 microm were determined. The degrees of contamination were compared and the effect of the input of a purification plant was examined. The sediments of the Lahn, which do not belong to the direct area of influence of a purification plant, as well as the sediments of the three tributary rivers are only weakly contaminated. Factor analysis was applied to achieve a data reduction. It suggests that the bonding of mercury to the sediments is caused mainly by organic substances. Adsorption or ion-exchange are of minor importance. (Murphy-IVI)
W84-03903

SURFACE RUNOFF WATER QUALITY COMPARISONS BETWEEN UNIMPROVED PASTURE AND WOODLAND,

Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, W. M. Edwards, and R. W. Van Keuren.

Journal of Environmental Quality, Vol. 12, No. 4, p 518-522, 1983. 2 Fig, 5 Tab, 23 Ref. EPA grant R-804631.

Descriptors: *Surface runoff, *Water quality, Comparison studies, Pastures, Woodlands, Chemical properties, Sediment transport, Organic compounds, Input-output analysis.

The influence of pasturing on surface runoff water quality was studied on a 26-ha, unimproved pasture watershed in eastcentral Ohio. Data were collected for 2 y with no cattle in the pasture and for 3 y with summer grazing by a 17-cow beef cattle herd. Because of springs and seep areas in the pasture, a small stream (accessible to the cattle) in the watershed flowed permanently. Samples of storm runoff were collected with a rotating vane sampler. The concentrations of most of the measured chemical parameters (NO3-N, mineral N, organic N, total P, K, Ca, Mg, Na, S, Cl, HCO3, total organic C, salts) in the storm discharge water were low and changed very little as a result of grazing. The weighted annual NO3-N concentrations for the ungrazed period and grazed period were 0.5 and 0.7 mg/L, respectively. A 17.7-ha, wooded watershed that contained no pastured areas and received no agricultural chemical limits, had concentrations of chemical parameters in surface discharge that were greater than or equal to those from the unimproved pasture during the grazing period. Nutrient transport during storm runoff from the unimproved pasture was greater during the 3-y period with summer grazing than during the 2-y, ungrazed period. This largely resulted from increased precipitation and subsequent increased surface runoff during the 3-y period. The transport levels from the pasture during the 3-y period were similar to or less than the transport levels from the wooded watershed during the same period. The increase in sediment transport from the pastured areas was more than could be attributed solely to the increased surface runoff. (Author's abstract)
W84-03930

AZINPHOSMETHYL AND FENVALERATE RUNOFF LOSS FROM A SUGARCANE-INSECT IPM SYSTEM,

Louisiana Agricultural Experiment Station, Baton Rouge.
S. Smith, T. E. Reagan, J. L. Flynn, and G. H. Willis.

Journal of Environmental Quality, Vol. 12, No. 4, p 534-537, 1983. 2 Tab, 19 Ref.

Descriptors: *Azinphosmethyl, *Fenvalerate, *Runoff loss, Runoff volume, Sugarcane, Insecticides, Aquatic habitats, Ecological effects.

Agriculture in the lower Mississippi River Valley greatly depends on the use of pesticides to help control severe weed and insect pest infestations and increase crop yields. Azinphosmethyl and fenvalerate were applied to sugarcane (Saccharum officinarum L.) runoff plots at rates of 0.84 and 0.22 kg/ha, respectively, 4 times each year in 1980 and 1981 as part of an insect integrated pest management (IPM) system research evaluation for season-long control of the primary sugar-cane insect pest, the sugarcane borer. Runoff samples (water + sediment) were collected within 8 ha after each storm and analyzed by gas chromatography. In 1980, runoff losses of azinphosmethyl and fenvalerate were 0.08 and 0.02%, respectively, of the amount applied. Runoff in 1981 was about twice that in 1980, partially accounting for larger insecticide runoff losses measured, 0.55 and 0.56% of that applied for azinphosmethyl and fenvalerate, respectively. The larger 1981 losses also were attributed to shorter time intervals between insecticide applications and runoff events. Azinphosmethyl concentrations in runoff do not appear to be harmful to surrounding aquatic habitats, whereas fenvalerate concentrations might present problems, particularly if applied at 0.22 kg/ha rates. (Murphy-IVI)
W84-03931

NUTRIENT CYCLING IN AN AGRICULTURAL WATERSHED: I. PHREATIC MOVEMENT,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.

Journal of Environmental Quality, Vol. 13, No. 1, p 22-27, 1984. 3 Fig, 3 Tab, 18 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Cycling nutrients, *Agricultural watershed, *Groundwater movement, Runoff, Subsurface runoff, Riparian ecosystem, Riparian vegetation, Nitrate, Phosphorus, Calcium, Magnesium, Potasium, Chloride, Sulfate, Sinks, Nutrient removal, Biological filters.

Much of the runoff from agricultural fields in the southeastern Coastal Plain is carried to a stream channel system in a shallow phreatic aquifer. This subsurface runoff often passes through a band of riparian forest before becoming streamflow. It is hypothesized that the riparian ecosystem acts as a nutrient sink and reduces the concentrations and loads of nutrients in the shallow aquifer before the nutrients reach the stream channel. Concentrations and loads (kg/sq m) of NO3-N, NH4-N, organic N, dissolved molydate-reactive P, total P, Ca, Mg, K, Cl, and SO4-S were measured in shallow phreatic wells at 37 locations on an agricultural watershed near Tifton, Ga. Total water volume moving off the watershed in subsurface flow was < 1% of streamflow with corresponding small amounts of nutrients. Nitrate-N, Ca, and Mg had significantly higher concentrations in field wells than in forest or streamside wells. Concentrations of Cl were not reduced as water moved from field to forest. Processes within the riparian zone apparently converted primarily inorganic N from fields (76% NO3-N, 6% NH4-N, 18% organic N) into primarily organic N in streamside wells (10% NO3-N, 14% NH4-N, and 76% organic N). Concentration differences between field and forest wells indicated the riparian forest's ability to act as a sink for NO3-N, Ca, Mg, K, and SO4-S. Due to their role as nutrient sinks, riparian forests are important in maintaining stream water quality on agricultural watersheds. (Author's abstract)
W84-03935

ATMOSPHERIC DEPOSITION AND ROOF-CATCHMENT CISTERN WATER QUALITY,

Pennsylvania State Univ., University Park. School of Forest Resources.
E. S. Young, Jr., and W. E. Sharpe.

Journal of Environmental Quality, Vol. 13, No. 1, p 38-43, 1984. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Roof-catchment cistern, *Water quality, Air pollution, Water pollution sources, Acid rain, Heavy metals, Water quality standards, Lead, Copper, Cadmium, Toxic metals, Clarion county, Indiana county, Pennsylvania.

Roof-catchment cistern systems consist mainly of a roof that functions as an impervious catchment for collecting precipitation and a storage tank, or cistern. The water is pumped from the cistern through a system of pipes to points of use within the house. The water quality in 40 roof-catchment cistern systems in rural Clarion and Indiana Counties, Pa. was studied to determine the impact of atmospheric deposition. Roof-catchment cisterns are open to atmospheric contaminants such as the toxic metals Pb and Cd, and corrosive acid components present in acid precipitation. Bulk precipitation samples failed to meet the drinking water standard for Pb on several occasions and were consistently quite corrosive. Mean Pb, Cd, and Cu concentrations were well below drinking water limits for all cistern water samples. Cistern water was corrosive in all but a few cases, as indicated by the Langelier saturation index, although not as corrosive as the bulk precipitation due to the dissolution of CaCO, from cistern walls and floors. Vinyl-lined cisterns contained water nearly as corrosive as the incoming precipitation. Seventy percent of the systems on one or more occasions exhibited cistern bottom sediment/water Pb or Cd concentrations that exceeded the drinking water limits. This indicated that metals deposited on roof catchments were accumulating at the bottom of the cisterns. Standing tap water samples exhibited high Pb and Cu concentrations. Nine of the forty systems studied produced standing tap water Pb concentrations that averaged above the drinking water standard. The mean Pb, Cd, and Cu concentrations of running tap water samples all fell below the drinking water standards. Atmospheric deposition of Pb and its infusion into tap water as a corrosion product pose a significant health threat to users of roof-catchment cistern systems in western Pennsylvania. (Murphy-IVI)
W84-03936

DISSIPATION OF PICLORAM IN STORM RUNOFF,

Agricultural Research Service, Temple, TX.
H. S. Mayeux, Jr., C. W. Richardson, R. W. Bovey, E. Burnett, and M. G. Merkle.

Journal of Environmental Quality, Vol. 13, No. 1, p 44-49, 1984. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Picloram, *Storm runoff, Nonpoint pollution sources, Herbicides, Watersheds, Riesel, Texas.

Picloram is currently used to control woody plants and herbacious weeds on rangelands. Its effectiveness is partially attributed to its greater persistence, compared with other herbicides, a characteristic which limits its use on cropped land. The extent of progressive decrease in concentration of the herbicide picloram (4-amino-3,5,6-trichloropicolinic acid) in intermittent streamflow was determined during runoff-producing storms. Maximum concentrations of picloram were 48 and 250 mg/cu m in initial runoff water leaving a sprayed 8-ha area in 1978 and 1979. Concentration decreased with distance from the treated area in proportion to the size of adjacent, untreated watershed subunits, which contributed runoff water to streamflow. Picloram concentrations usually decreased with each successive runoff event; an exception occurred when unusually large quantities of runoff (8.7 cm) diluted concentrations to levels less than those observed in the succeeding event (1.4 cm runoff). About 6% of the applied picloram left the treated area during a period of 1 month when conditions were especially conducive to transport of the herbicide in surface runoff water. Rapid dilution of picloram was observed after direct introduction of the herbicide near the upper end of a larger stream during rising stage of flow. Maximum concentrations at 90, 1170, and 5400 m downstream from the point of introduction of 1270 g of picloram were 13 720, 470, and 5 mg/cu m, respectively. The calculated quantity of picloram which was detected at the 5400-m sampling point in streamflow was only 0.13% of that introduced. Mixing of water during streamflow and additions of uncontaminated water along the channel apparently reduced picloram concentration to below that detectable by gas chromatography. (Murphy-IVI)
W84-03937

ALGAL AVAILABILITY OF PHOSPHORUS IN SUSPENDED STREAM SEDIMENTS OF VARYING PARTICLE SIZE,

Purdue Univ., Lafayette, IN. Dept. of Agronomy.
R. A. Dorich, D. W. Nelson, and L. E. Sommers.

Journal of Environmental Quality, Vol. 13, No. 1, p 82-86, 1984. 4 Tab, 23 Ref. EPA grant G00533501.

Descriptors: *Algae, *Phosphorus, *Streams, *Suspended sediments, *Particle size, Agricultural watersheds, Inorganic phosphorus, Eutrophication, Bioassay, Algal growth.

Phosphorus limits algal growth in many aquatic systems and inputs of P into such systems have caused algal blooms and associated water quality problems. The availability of sediment P to algae was evaluated in several water stable aggregate-size fractions of suspended stream sediments collected from an agricultural watershed in northeastern Indiana. Sediments were collected during a

storm event, separated into the < 2, 2 to 20, 20 to 53, 53 to 212, and > 212 microm size fractions, sterilized by gamma irradiation, and incubated for 2 weeks with algae. Algal-available P (Paa) was determined by measuring decreases in the NaOH- and HCl-extractable inorganic P (Pi) fractions in sediment during the incubation period. The initial concentrations of P in the NaOH- and HCl-extractable Pi fractions were not related to aggregate size. All aggregate-size fractions had similar Paa concentrations. Nearly equal proportions of sediment Pi (avg 79%) and total P (avg 43%) in aggregate fractions were available to algae, possibly resulting from the similar distribution of primary particle sizes in all aggregate-size fractions. More than 93% of Paa originated in the NaOH-extractable P fraction. Samples that were affected by septic effluents tended to be higher in certain sediment P parameters (e.g., NaOH-extractable Pi, total Pi, total P, and Paa concentrations) than samples containing suspended sediment derived from cropland. This study suggests that runoff models may not need to account for the detachment and transport of aggregate-size classes to predict the movement of algal-available P from cropland to surface waters. (Murphy-IVI)
W84-03939

CYANAZINE LOSSES IN RUNOFF FROM NO-TILLAGE CORN IN 'LIVING' AND DEAD MULCHES VS. UNMULCHED, CONVENTIONAL TILLAGE,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2E.
W84-03941

FACTORS AFFECTING PHOSPHORUS LOSSES FROM CULTIVATED ORGANIC SOILS,
North Carolina State Univ. at Raleigh.
C. Cogger, and J. M. Duxbury.
Journal of Environmental Quality, Vol. 13, No. 1, p 111-114, 1984. 4 Fig, 4 Tab, 22 Ref.

Descriptors: *Phosphorus, *Soil organic matter, Leaching, Water quality, Soil horizons, Aluminum, Iron, Fertilization, Nonpoint pollution sources, Phosphorus absorption, Fertilization, Histosols, New York.

Organic soils play an important role in agricultural production, but their potential as nonpoint sources of pollution through nutrient leaching is also important. Leaching losses of P from organic soils can have a marked effect on water quality. Factors affecting leaching loss of P from cultivated organic soils in western New York State (Carlisle and Palms series) and ways to reduce these losses were investigated. The behavior of P in organic soils from eight sites with annual leaching losses ranging from < 1 to > 30 kg/ha/y was compared. Inorganic, organic, and total P; P extracted by soil test procedures; percent mineral matter; depth of organic horizons; leaching and adsorption of P; release of P during incubation; and total extractable Al and Fe were compared. Phosphorus balance was estimated using field and laboratory data, and cropping and fertilization history. Aluminum, iron and adsorption equilibria were the best predictors of field leaching losses from these soils. While P loss from these soils is controlled by adsorption reactions, the best way to reduce the loss is through fertilizer management. (Murphy-IVI)
W84-03942

ATRAZINE AND SIMAZINE MOVEMENT TO WYE RIVER ESTUARY,
Agricultural Research Service, Beltsville, MD. Soil Nitrogen and Environmental Chemistry Lab.
D. E. Glotfelty, A. W. Taylor, A. R. Isensee, J. Jersey, and S. Glenn.
Journal of Environmental Quality, Vol. 13, No. 1, p 115-121, 1984. 5 Fig, 3 Tab, 29 Ref.

Descriptors: *Atrazine, *Simazine, *Wye River, *Estuaries, Runoff, Agricultural runoff, Agricultural watersheds, Herbicides, Water pollution sources, Fate of pollutants, Chesapeake Bay.

The Wye River, a tributary of Chesapeake Bay, is a shallow, well-mixed estuary surrounded by an agricultural watershed, a large portion of which is planted in corn (Zea mays L.). A 3-y study of the movement of atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine) and simazine (2-chloro-4,6-bis (ethylamino)-s-triazine) showed that the total amount of herbicide reaching the estuary depended upon the quality applied in the watershed and the timing of runoff with respect to application dates. In a year in which significant runoff occurred within 2 weeks of application, 2 to 3% of the atrazine moved to the estuary. In other years with less runoff, or runoff delayed longer after application, much smaller quantities reached the estuary. Simazine loading was one-tenth that of atrazine. Once in the estuary, atrazine and simazine remained in solution, diluted in a conservative manner with estuarine water, and dissipated with a 10- to 30- d half-life. The maximum measured concentration of atrazine was near 15 microg/L but average concentration at peak loading was < 3 microg/L. Thus, although the Wye River has a high percentage of watershed land planted to corn, herbicide concentrations rarely approached those producing minor effects on submerged aquatic vegetation. (Author's abstract)
W84-03943

PASTURE RUNOFF WATER QUALITY FROM APPLICATION OF INORGANIC AND ORGANIC NITROGEN SOURCES,
Clemson Univ., SC. Dept. of Agricultural Engineering.
R. V. McLeod, and R. O. Hegg.
Journal of Environmental Quality, Vol. 13, No. 1, p 122-126, 1984. 7 Fig, 4 Tab, 12 Ref.

Descriptors: *Agricultural runoff, *Water quality, *Nitrogen, Nitrogen compounds, Water pollution sources, Fertilization, Waste disposal, Municipal wastewater, Manure, Water pollution, Fertilizer, Ammonium nitrate.

After an organic waste has been applied to a soil, some of the waste may be transported by rainfall runoff, snowmelt, or irrigation runoff into surface waters. Surface runoff water quality from a fescue pasture receiving surface application of organic wastes and commercial fertilizer was evaluated at Clemson University (Clemson, S.C.). Dairy manure, poultry manure, and municipal sludge were the organic wastes used in this experiment. Ammonium nitrate was the commercial fertilizer. The organic wastes and commercial fertilizer were applied at the rate of 112 kg N/ha to eight plots during four different periods. Due to an extremely dry year, runoff events were produced by irrigation. The runoff water was collected and samples were analyzed for pH, total P, total suspended solids, total Kjeldahl N, NH4-N, NO3-N, and chemical oxygen demand. The nutrient concentrations in surface runoff were more dependent on the number of rainfalls since application of the fertilizer than on the quantity of rainfall or runoff. The concentrations of potential pollutants from surface-applied organic wastes or commercial fertilizer were reduced by between 80 and 55% after two runoff events. The NO3-N concentration in the surface runoff from the plots receiving the commercial fertilizer exceeded the permissible public water supply standard during the first runoff event. The overall nutrient loss in the runoff was found to be minimal (< 4% of total Kjeldahl N and chemical oxygen demand and < 2.5% of total P). (Murphy-IVI)
W84-03944

BRYOZOANS-POSSIBLE INDICATORS OF ENVIRONMENTAL QUALITY IN BEAR CREEK, MISSISSIPPI,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. M. Cooper, and J. W. Burris.
Journal of Environmental Quality, Vol. 13, No. 1, p 127-130, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Bryozoans, *Bioindicators, *Bear Creek, *Mississippi, Aquatic ecosystem, Agricultural watersheds, Water quality, Suspended sediments, Sedimentation rates, Habitat, Water pollution effects, Hydrogen ion concentration.

Bryozoans do not indicate pollution by their presence, but some species have been considered pollution indicators by their absence. Collections of samples of water and substrate materials from lakes and stream sections of Bear Creek, Miss., were studied to determine the species of Bryozoa present in different habitats of an aquatic ecosystem with an intensively cultivated flatland watershed (440 km2). Bear Creek (83 km long), a tributary of the Yazoo River in the Mississippi River alluvial delta, is actually a series of six riverine lakes connected by a sluggishly flowing stream. The watershed also includes several other oxbow lakes connected to the stream only during periods of high discharge. Water quality as characterized by total and suspended sediments, deposited sediments, pH, and coliforms deteriorated in a downstream direction. Four species of the sessile colonial invertebrate were indigenous to the three lakes in the system having the lowest total solids, sedimentation rates, and pH. These included Plumatella fruticosa (Allman), Lophopus crystallinus (Pallas), Fredericella sultana (Blumenbach), and Pectinatella magnifica (Leidy). Absence of bryozoans, especially environmentally sensitive Pectinatella magnifica, in downstream areas correlated with degradation of downstream habitat and increased total solids. Selective habitation of these invertebrates in the Bear Creek stream system indicates the possible use of these organisms as environmental indicators of habitat quality. (Murphy-IVI)
W84-03945

DISSOLVED MINERAL SALTS DERIVED FROM MANCOS SHALE,
Kentucky Agricultural Experiment Station, Lexington. Dept. of Agronomy.
V. P. Evangelou, L. D. Whittig, and K. K. Tanji.
Journal of Environmental Quality, Vol. 13, No. 1, p 146-150, 1984. 1 Fig, 4 Tab, 9 Ref. OWRT project B-201-CAL, WRC project UCAL-WRC-W-582; OWRT grant P.L. 95-467.

Descriptors: *Mancos Shale, *Salinity, Gypsum, Alkaline earth carbonates, Mica, Kaolin, Smectite, Mica-vermiculite, Water pollution sources, Fate of pollutants, Cation exchange, Colorado River basin.

The Mancos shale, a sedimentary Upper Cretaceous marine formation exposed over extensive areas in the Upper Colorado River Basin, is recognized as a major contributor to the dissolved mineral salt load in the Colorado River system. It contains gypsum and alkaline earth carbonates, and its clay mineralogy is mica, kaolin, smectite, and interstratified mica-vermiculite. Selected surface samples of partially weathered Mancos shale were also found to contain from 281 to 345 g/kg clay (< 2 microm diam) and to exhibit cation exchange capacities (CEC) ranging from 13.25 to 19.96 cmol/kg. Water suspension extracts from partially weathered shale (1:5 and 1:10 shale/water ratios) were saturated with respect to gypsum (electrical conductivity (EC) values up to 3.16 dS/m and soluble Ca and SO4 up to 25.90 and 40.95 mmol/+ or - L, respectively). Additional Na, K, and Mg released by water indicated sources of soluble ions other than gypsum. Water extracts from unweathered shale yielded much higher quantities of Na (and higher Mg in most cases) than did comparable extracts from partially weathered shale. Barium chloride released larger quantities of Mg from both partially weathered and unweathered shale and large quantities of Na from unweathered shale than did water at comparable dilutions. The data substantiate the important role of the cation exchange complex in retention and release of soluble ions in Mancos shale. Sodium and magnesium were preferentially adsorbed by phyllosilicates within the shale and Ca was precipitated as calcite and gypsum following emergence after deposition in the Cretaceous sea. This cycle is essentially reversed in the present environment. Dispersed gypsum and alkaline earth carbonates provide soluble Ca to displace adsorbed Na and Mg that add to the dissolved mineral salt load of the Colorado River system. (Author's abstract)
W84-03947

SHALLOW GROUNDWATER QUALITY BENEATH AN INTENSIVE MULTIPLE-CROPPING SYSTEM USING CENTER PIVOT IRRIGATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. K. Hubbard, L. E. Asmussen, and H. D. Allison.
Journal of Environmental Quality, Vol. 13, No. 1, p 156-161, 1984. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Shallow groundwater, *Water quality, *Multiple-cropping, Center pivot irrigation, Nitrogen compounds, Irrigation design, Irrigation effects, Groundwater pollution, Groundwater level, Soil horizons, Nitrate, Nitrogen, Leaching, Sandy soils, Coastal plain, Sprinkler irrigation, Fertilization, Groundwater flow.

Substantial increases in groundwater NO3-N are of particular concern on intensively cropped irrigated sandy soils. A study was conducted to compare shallow groundwater NO3-N concentrations under intensive multiple cropping systems with those from under nearby nonagricultural sites. The intensive multiple cropping systems involved center pivot irrigation and sprinkler-applied fertilizer. The study was conducted on a sandy Coastal Plain soil by weekly measurement and sampling of observation wells located under a center pivot area and at two forest sites. Nitrate-N concentrations under the center pivot area ranged from < 1 mg/L to about 133 mg/L, with a mean of 20 mg/L (n = 360, SD = 19.5). In contrast, samples from the forest sites had NO3-N concentrations ranging from < 0.1 mg/L to just over 1 mg/L. Mean NO3-N concentrations under the center pivot area were found to vary seasonally according to cropping and hydrologic patterns such that the mean values for March-May, June-August, September-November, and December-February were 7, 21, 27, and 21 mg/L, respectively. The lower value for March-May indicated that winter rains leached most of the root zone NO3-N beneath the wells by March, and that there was a 2 to 3 month lag between spring-applied N and its appearance in shallow groundwater. The study raises concern about shallow groundwater quality under intense multiple cropping systems on sandy soils. Although studies in this physiographic area of the Coastal Plain have shown that relatively impermeable subsoil horizons cause shallow groundwater to flow laterally to the larger drainage networks, and that alluvial forest then remove most of the N, the results of this study imply that groundwater NO3-N contamination could be a problem in other physiographic areas having sandy soils lacking such subsoil horizons. (Murphy-IVI)
W84-03949

RHODE ISLAND IMPOSES STRICT LIABILITY FOR CONTAMINATION OF WATER BY PERCOLATION OF POLLUTANTS FROM ILLEGAL DUMP SITE,
For primary bibliographic entry see Field 6E.
W84-03967

GREAT DRAIN ROBBERY,
F. Pearce.
New Scientist, Vol. 101, No. 1401, p 10-16, 15 March 1984. 4 Fig.

Descriptors: *Legislation, *Water pollution control, *Great Britain, Water pollution sources, Industrial wastes, Waste disposal, Waste dumps, Estuaries, Environmental effects, Tees Estuary.

Efforts on the part of the British government to legislate water pollution control are reviewed and cases are cited which suggest that these measures have in large part failed to have any real effect on the problem. The Control of Pollution Act was approved by parliament some 10 years ago. Over the past 30 years many of Britains worst polluters, the oil refineries, chemical works, steel plants and paper mills, have moved to the coasts and estuaries. Four government inquiries have been made as to how to clean up the Tees, Britain's most polluted estuary. Until last September local councils made most of the appointments to water authorities. The authorities are now wholly made up of ministers' nominees. Ministers appear to have a penchant for putting men from the top British companies onto the authorities. Specific examples of extreme cases of water pollution are cited. (Baker-IVI)
W84-03971

LONGITUDINAL DISPERSION IN A STREAM CALCULATED BY ONE DIMENSIONAL NUMERICAL MODEL,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2E.
W84-03975

QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF URBAN DISCHARGE TO SMALL RIVER BASINS IN THE SOUTH WEST OF SWEDEN,
Lund Univ. (Sweden).
W. Hogland, and R. Berndtsson.
Nordic Hydrology, Vol. 14, No. 3, p 155-166, 1983. 11 Fig, 1 Tab, 5 Ref.

Descriptors: *Rainfall-runoff relationships, *Urban runoff, *Sweden, *Lund, *Water pollution sources, Phosphorus, Snowmelt, Industrial wastes, Pollutograph, Copper, Zinc, Lead.

In the southwest of Sweden a common type of recipient for urban discharge is small rivers and creeks. Due to large variations in flow of these recipients, the polluted discharge can have different effects on aquatic life. The most critical periods often occur during summer. This is due to the very low flow during summer and heavy rainstorms which flush gutters and sewage pipes of pollutants and may cause combined sewer overflows. The receiving water for the city of Lund, Hoje river, is a typical recipient of urban discharge and is representative for the southwest of Sweden. Variations in pollution concentrations often occur within short time-periods. High concentrations in urban storm water can usually be traced to local pollution-sources. Examples of extreme values of different pollutants in urban stormwater from Lund are given. The high phosphorus concentration was due to overflow. High copper and zinc concentrations were found in areas with corroding copper and zinc roofs. Usually 75% of all data occurs around a narrow interval. When concentration values are found outside this interval, there is likely to be a local pollution source responsible. Such infomation can be used as an indicator for random samples. (Baker-IVI)
W84-03984

DISPERSION OF POLLUTANTS IN SEMI-INFINITE POROUS MEDIA WITH UNSTEADY VELOCITY DISTRIBUTION,
Banaras Hindu Univ., Varanasi (India). Dept. of Mathematics.
N. Kumar.
Nordic Hydrology, Vol. 14. No. 3, p 167-178, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Path of pollutants, *Seepage, *Porous media, *Dispersion, Flow, Water quality management, Water pollution control, Mathematical equations, Velocity, Groundwater movement.

Analytical solutions are developed for the dispersion problem in nonadsorbing and adsorbing, semi-infinite porous media in which the flow is one dimensional and the average flow velocity is unsteady. The expression that states the direct relationship of the dispersion coefficient with seepage velocity is used to solve the unsteady dispersion flow problem by introducing a new time variable. The source concentration of the pollutant varies exponentially with time. The variation in seepage velocity with time is considered because of resistance in the flow. The graphical solutions are also obtained for a set of data assumed. The analytical expressions obtained are useful to the study of salinity intrusion in groundwater, helpful in making quantitative predictions on the possible contamination of groundwater supplies resulting from groundwater movement through buried wastes. In addition, they should prove useful for other processes such as ion exchange in soils and decay of organic substances. (Baker-IVI)
W84-03985

ATMOSPHERIC NUTRIENT LOADINGS TO THE VENETIAN LAGOON,
Politecnico di Milano (Italy). Ist. di Ingegneria Sanitaria.
M. Guigliano, and R. Cossu.
The Science of the Total Environment, Vol. 29, No. 1/2, p 49-63, July 1983. 4 Fig, 5 Tab, 17 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Lagoons, *Venice, *Italy, Fallout, Eutrophication, Adriatic Sea, Nutrients, Air pollution, Water pollution sources, Path of pollutants, Rainfall.

For the Lagoon of Venice (Italy), an evaluation of the nutrient loads discharged from the atmosphere is of particular interest, both because there are clear symptoms of progressive eutrophication of the lagoon as a whole and because there are industries in the area which emit nitrogen and phosphorus compounds which can increase the quantities carried in the air. Samples were taken from four points near the center of the lagoon around the city of Venice, over a period of 30 months. Monthly samples of rainwater were collected and analyzed for chemicals that showed the presence of nutrients (all the forms of nitrogen and phosphorus). The relationships between the various analytical parameters, sampling area, extent of the rainfall, and wind directions were studied using correlation coefficient matrices. The total quantity of nutrients that the atmosphere contributes to the lagoon is quite substantial and should not be ignored in the chemical balance of the ecosystem. (Baker-IVI)
W84-03997

ABUNDANCE OF SOME MAJOR AND TRACE ELEMENTS IN HIGHLY POLLUTED SEDIMENTS FROM THE RHINE RIVER NEAR MAINZ, WEST GERMANY,
Mainz Univ. (Germany, F.R.). Inst. fuer Geowissenschaften.
C. B. Dissanayake, H. J. Tobschall, H. Palme, U. Rast, and B. Spettel.
The Science of the Total Environment, Vol. 29, No. 3, p 243-260, August, 1983. 5 Fig, 3 Tab, 42 Ref.

Descriptors: *River sediments, *Pollutants, *Rhine River, *West Germany, *Mainz, Zinc, Silver, Gold, Rare earth elements, Uranium, Thorium, Chromium, Mercury, Cadmium, Hafnium, Galvinium, Sediments, Organic compounds.

The Ginsheimer Altrhein, which is a cut-off channel of the River Rhine near Mainz, is highly polluted, receiving waste effluent form a large industrial region. Neutron activation analysis was used to determine the abundances of 40 elements, including the rare earths, in the surface sediments of the River Ginsheimer Altrhein. Samples taken from 5 stations along the river contained very high concentrations of some elements such as zinc, 7160 ppm; silver, 154 ppm; gold, 750 ppb; copper 260 ppm; mercury, 94 ppm; and chromium, 1780 ppm. Significant enrichment due to anthropogenic sources was not evident among thorium (4-9 ppm) or uranium (2-8 ppm). Chalcophile, siderophile and lithophile elements showed very high positive correlations with organic carbon while the rare earth elements of Th, Hf, Ca, K, Ga, and Sc had negative correlations. (Baker-IVI)
W84-03998

IMPACT OF SEWAGE TREATMENT PLANTS ON SURFACE WATERS,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, N. E. Brown, C. L. Cherwinsky, G. D. Jenkins, and D. A. Cotter.
Canadian Journal of Public Health, Vol. 75, No. 1, p 25-31, January/February, 1984. 2 Fig, 4 Tab, 37 Ref.

Descriptors: *Environmental impact statement, *Wastewater disposal, Surface water, Microbiolo-

gical studies, Wastewater pollution, Wastewater treatment, Chlorination, Bacteria, Staphylococcus, Amoebae, Viruses, Reoviruses, Adenoviruses, Enteroviruses, Coxsackie virus, Poliovirus, Recreation, Great Lakes, Lake Ontario.

The recent closure of some Ontario beaches has prompted investigations into possible sources of contamination of Lake Ontario. The role of sewage treatment plant effluents in microbial pollution of suface waters was analyzed through raw sewage, nonchlorinated and chlorinated effluent, and receiving waters for bacteria, amoebae and viruses. Determinations of total staphylococci, Pseudomonas aeruginosa, total coliforms, fecal coliforms, and fecal streptococci, from the raw sewage and outflow pipes of three sewage treatment plants, indicated that these organisms had a 0.02 to 0.008% survival rate after chlorination. Naegleria sp. were isolated from the raw sewage and sewage effluent of all three plants and, at one plant, the amoebae were also recovered from the chlorinated effluent and the lake water. Viruses were detected in 100% (11/11) of raw sewage, 63% (5/8) of nonchlorinated effluent, 40% (4/10) of chlorinated effluent and 4% (1/23) of receiving water samples. The viruses, identified using direct electron microscopic examination in combination with immunoelectron microscopy, were found to be reo-, adeno-, and enterovirus, coxsackievirus A9, B2 and B4, and poliovirus types 2 and 3. This study demonstrates that sewage treatment plants may have a detrimental impact on the water quality of recreational beaches. (Murphy-IVI)
W84-04010

ASSOCIATION OF NAEGLERIA FOWLERI WITH THE CHEMICAL, MICROBIOLOGICAL AND PHYSICAL CHARACTERISTICS OF SOUTH AUSTRALIAN WATER SUPPLIES,
South Australian Health Commission, Adelaide.
A. Esterman, M. Dorsch, S. Cameron, D. Roder, and B. Robinson.
Water Resources, Vol. 18, No. 5, p 549-553, 1984. 6 Tab, 10 Ref, 2 append.

Descriptors: *Naegleria fowleri, *Chemical properties, *Physical properties, *Microbiologal studies, Water supply, Amoebae, Pathogens, Water quality, Ecological distribution, Physiological ecology, Australia, Primary amoebic meningoencephalitis.

Primary amoebic meningoencephalitis (PAM) is a rare, though rapidly fatal, infection of the meninges and brain caused by the amoeba Naegleria fowleri. Control samples were compared with 102 water samples containing this pathogen. Generally, two controls were available for each sample where N. fowleri was detected. Univariate comparisons revealed a positive association of N. fowleri with: (a) water temperature; (b) maximum and minimum air temperature; (c) bacterial colony counts at 20 and 35 degrees C; (d) the total coliform count; (e) amoebae other than Naegleria and (f) Naegleria sp. other than N. fowleri. By comparison, negative associations were evident with free and total chlorine residuals. A conditional logistic regression analaysis indicated that N. fowleri isolation was positively and independently associated with: (a) water temperature; (b) maximum air temperature; (c) bacterial colony counts at 35 degrees C; and (d) low free chlorine residual. Negative associations were found with high temperature tolerant Naegleria and Acanthamoeba, but it is considered that these findings may reflect laboratory technique, not genuine ecological relationships. Evidence is presented that probability of detecting N. fowleri would vary markedly with the changes in mean water temperatures and maximum daily air temperature that occur by season. On the basis of temperature variations alone, and assuming a constant free chlorine residual, it is estimated that the probability of N. fowleri occurring (at detectable levels) would be 53 times higher in summer, eleven times higher in autumn, and six times higher in spring, than it would be in the winter. These are very approximate estimations which may not apply to an individual sampling site, nor to periods of extreme temperature. While this is a preliminary study, statistical associations of N. fowleri with a variety of ecological measures have been quantified. More comprehensive and detailed studies are required to further clarify the ecological relationships of this organism. (Murphy-IVI)
W84-04021

OCCURRENCE OF ROTA- AND ENTEROVIRUSES IN DRINKING AND ENVIRONMENTAL WATER IN A DEVELOPING NATION,
Texas Univ. Health Science Center at Houston.
T. R. Deetz, E. M. Smith, S. M. Goyal, C. P. Gerba, and J. J. Vollet, III.
Water Resources, Vol. 18, No. 5, p 567-571, 1984. 2 Tab, 25 Ref. NIH grant E30-1738 and contract AI-10266s.

Descriptors: *Rotaviruses, *Enteroviruses, *Drinking water, *Natural waters, Developing countries, Coliform, Coxsackie virus, Water quality, Standards, Potable water, Mexico.

Rotaviruses have been implicated as a major cause of childhood and traveler's diarrhea in developing countries. Since water is known to be a vehicle of transmission of other enteric viruses, we sought to determine if water could play a role in the transmission of rotavirus infections in a developing nation by applying recently developed techniques for the concentration of viruses from tapwater and environmental (lake, river, ocean and aqueduct) water in Mexico. In an initial survey during the rainy season in August 1978, rotavirus was detected in 10 of 10 drinking water samples and coxsackie B4 or B6 virus in 5 of 10. In a larger survey during the dry season in December 1979, rotavirus was recovered from 3 and enteric viruses from 8 of 21 drinking water samples. Water quality data, available for the 1979 survey, indicated that while many tapwater samples did not meet U.S. coliform standards, some samples containing infectious virus did. Our data suggest that current bacteriological water quality standards for potable water do not reflect viral contamination. (Author's abstract)
W84-04023

MEASUREMENT OF ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN FRESHWATER SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Water Resources, Vol. 18, No. 5, p 581-584, 1984. 6 Fig, 2 Tab, 9 Ref.

Descriptors: *Electron transport system, *Sediment, Electrochemistry, Electron transport, Microbial degradation, Oxygen requirements.

Electron transport system (ETS) activity was measured in freshwater sediment at 4, 10 and 20 degrees C by following the reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) to iodonitrotetrazolium (INT-formazan). The rate of INT-formazan formation was dependent upon the incubation temperature and nutrient amendments. Electron transport system activity also correlated very highly with O2 consumption rates in the same sediment. (Author's abstract)
W84-04024

BACTERIA IN DISTRIBUTION SYSTEMS (LA FLORE BACTERIENNE DANS UN RESEAU DE DISTRIBUTION),
Compagnie Generale des Eaux, Paris (France).
M. M. Bourbigot, A. Dodin, and R. Lheritier.
Water Resources, Vol. 18, No. 5, p 585-591, 1984. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Bacteria, *Water distribution, Water quality, Drinking water, Disinfection, Bacterial analysis, Water treatment, Paris, France.

Water quality upkeep in distribution systems is a major concern of drinking water suppliers, especially where systems transport water through several thousand kilometers of pipelines. The Water Authority for the Paris Suburbs' decided to modify treatment at the Mery-sur-Oise drinking water production plant. The old line was upgraded by the addition of a raw water basin, two more ozonation stages, and activated carbon filtration. Pre-chlorination is no longer used at the plant. A study to assess the impact of these changes on the quality of water in the system was launched prior to the switchover. It involved the enumeration and identification of the germs in analyzed samples of river water, treated water and distributed water. The mean value of the total bacterial aftergrowth in the distribution system of the old line, at 20 degrees C exceeded the limit value of the European standards (100 germs/ml). Removal of the biodegradable fraction of organics during treatment probably limits the aftergrowth, in spite of lower post-chlorination dosages. Moreover, chlorine is now in the form of free chlorine. TOC removal has been increased slighty by the new line, but the permanganate consumption has been greatly reduced, from 1.5 to 0.5/mg at the plant outlet. In river water, the germs are mainly Escherichia, Aeromonas hydrophila, Acinetobacter calcoaceticus, Alcaligenes faecalis. Yersinia enterocolitica were isolated in 6% of the samples. At the plant outlet, the samples are mostly uncontaminated in analysis conditions. In the distribution system, the species isolated are Aeromonas hydrophila and Alcaligenes faecalis. Enterobacteriaceae and Pseudomonodaceae also contaminated the samples, but with a very low frequency (5%). Many acid-fast bacteria species were isolated in river water (M. fortuitum, M. chelonei, M. terrae and M. lactis). But no species were found in samples of 250 ml at the plant outlet. 39 acid-fast bacteria were isolated from 126 samples of distributed water. Most germs belong to Runyon's group II but were not identified. The onset of deterioration of bacteriological quality may be a criterion for selecting the regeneration cycle for activated carbon. (Murphy-IVI)
W84-04025

SEDIMENTARY COPROSTANOL AND HYDROCARBON DISTRIBUTION ADJACENT TO A SEWAGE OUTFALL,
Mote Marine Lab., Sarasota, FL.
R. C. Brown, and T. L. Wade.
Water Resources, Vol. 18, No. 5, p 621-632, 1984. 9 Fig, 3 Tab, 38 Ref.

Descriptors: *Coprostanol, *Hydrocarbons, *Wastewater outfall, Fate of pollutants, Sediments, Indicators.

The concentrations of coprostanol and hydrocarbons were measured in the effluent from the Chesapeake-Elizabeth sewage treatment plant (STP) and surface sediments from the area surrounding the effluent discharge site. Most of the coprostanol (> 84%) and hydrocarbons (> 91%) were associated with particulates in the effluent. The area was found to be dynamic where changes in the percentage and distribution of fine grained sediments occur over periods of months and the movement of these sediments is an important determinant of the distribution of sewage derived contaminants. The Chesapeake-Elizabeth STP was found to be responsible for only 7% of the hydrocarbon contamination of the sediments in the study area. The sediment hydrocarbon distribution also indicates that the Bay Bridge tunnel may be a unique source of hydrocarbons to the lower Chesapeake Bay. This study shows the usefulness of coprostanol in providing a better understanding of the fate and importance of sewage derived contaminants in areas around sewage outfalls. (Author's abstract)
W84-04028

BEHAVIOR OF FE, MN, CU AND CD IN THE DUWAMISH RIVER ESTUARY DOWNSTREAM OF A SEWAGE TREATMENT PLANT,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson, R. A. Feely, H. C. Curl, and J. F. Gendron.
Water Resources, Vol. 18, No. 5, p 633-641, 1984. 6 Fig, 2 Tab, 34 Ref, 1 Append.

Descriptors: *Behavior, *Iron, *Magnesium, *Copper, *Cadmium, *Duwamish River,

Wastewater outfall, Estuaries, Chemical properties, Fate of pollutants, Seattle, Washington.

Although the fate of sewage-derived trace metals in fresh and marine waters is only beginning to be understood, their partitioning between dissolved and particulate phases is known to play an important role in determining their fate. The behavior of dissolved Fe, Mn, Cu and Cd in the Duwamish River downstream of a sewage treatment plant located near Seattle, Washington, was investigated in three distinct zones: (1) immediately downstream of the effluent outfall, (2) further downstream in the freshwater portion of the river and (3) in the estuaring mixing zone. A three-end-member tracer model utilizing salinity and dissolved inorganic nitrogen was developed to distinguish physical mixing process from biogeochemical reactions. The results of this investigations indicate that Fe was removed from the dissolved phase onto particulates near the plant. Although no additional reactions controlled the distribution of dissolved Fe, Mn and Cu in the freshwater portion of the river, Cd was removed from the dissolved phase. In the estuarine mixing zone, a significant fraction of the dissolved Fe and Cu was removed from solution, while Mn and Cd desorbed from particulates. The chemical forms of the trace metals rather than their sources appear to determine their participation in these reactions. (Murphy-IVI)
W84-04029

RESIDUES OF ORGANOCHLORINE INSECTICIDES, POLYCHLORINATED BIPHENYLS, AND HEAVY METALS IN BIOTA FROM APALACHICOLA RIVER, FLORIDA, 1978,
Georgia Univ., Athens.
P. V. Winger, C. Sieckman, T. W. May, and W. W. Johnson.
Journal Association of Official Analytical Chemists, Vol. 67, No. 2, March-April, 1984. 3 Fig, 8 Tab, 28 Ref.

Descriptors: *Organochlorine insecticides, *Polychlorinated biphenyls, *Heavy metals, *Biota, *Apalachicola River, Insecticides, DDT, Toxaphene, Organic compounds, Organic pesticides, Standards, Water pollution, Fate of pollutants, Bioindicators, Florida.

Seventy-seven composite samples composed of largemouth bass (Micropterus salmoides), channel catfish (Ictaluras punctatus), threadfin shad (Dorosoma petenense), Asiatic clam (Corbicula Fluminea), burrowing mayfly (Hexagenia sp.), water snake (Natrix spp.), and little green heron (Butorides virescens) were collected from upper and lower reaches of the Apalachicola River, Florida, in 1978 for residue analysis of organochlorine insecticides, PCBs (polychlorinated biphenyls), and metals. Compared with data from the National Pesticide Monitoring Program and criteria recommended for the protection of aquatic life, residue concentrations were moderately high in the Apalachicola River. Biota from the upper river generally had higher organic and lower metal residues than those from the lower river. Highest residues in the biota were total DDT, total PCBs, and toxaphene. Although individual mean concentrations were below 2 microg/g and total organic contaminant residues never exceeded 5 microg/g, residue concentrations of DDT, PCBs, and toxaphene (particularly from the upper river) exceeded recommended permissible levels for the protection of aquatic life. Metal residues were generally below 1 microg/g. Exceptions were arsenic residues in threadfin shad (1.07 microg/g) and Asiatic clams (1.75 microg/g), and selenium in eggs of channel catfish (1.39 microg/g). The residues observed in the biota, particularly from the upper station, indicated moderate contamination of the Apalachicola River system at the time samples were collected. (Author's abstract)
W84-04033

ADSORPTION OF HYDROPHOBIC POLLUTANTS IN ESTUARIES,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. P. Connolly, N. E. Armstrong, and R. W. Miksad.
Journal of Environmental Engineering, Vol. 109, No. 1, p 17-35, February, 1983. 13 Fig, 2 Tab, 23 Ref.

Descriptors: *Fate of pollutants, *Kepone, *Estuaries, *Adsorption, Suspended sediments, Simulation, Model studies, Tidal effects, Resuspension, Mathematical models, Pesticides.

Using Kepone as the test compound, the relation of sediment suspension to fate of hydrophobic pollutants through adsorption is examined. Adsorption experiments show rapid attainment of an equilibrium condition that is a linear function of dissolved Kepone concentration and an inverse non-linear function of adsorbing solids concentration. An apparatus creating a one-dimensional distribution of suspended sediment over a sediment bed is used to experimentally simulate an estuarine tidal cycle during which the transfer of Kepone from the bed to water column is examined. A mathematical model of the adsorption and sediment resuspension process is used to analyze the experimental results. Resuspension and the variation of adsorption equilibrium with solids concentration are shown to be significant to the transfer. Adsorption kinetics are not significant because of the rapid approach to equilibrium. (Author's abstract)
W84-04042

ORGANIC CARBON DECAY IN STREAM WITH BIOFILM KINETICS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
S. Srinanthakumar, and A. Amirtharajah.
Journal of Environmental Engineering, Vol. 109, No. 1, p 102-119, February, 1983. 14 Fig, 42 Ref.

Descriptors: *Biofilms, *Microorganisms, *Fate of pollutants, *Kinetics, *Mathematical models, *Organic carbon, Decomposition, Streams, Wastewater, Biomass, Velocity, Water temperature.

The importance of sessile microbial populations in aquatic environments has been recognized for many years especially the heterotrophic slimes under polluted conditions. However, models proposed by previous researchers to predict substrate decay rates have been based on first order or Monod kinetic expressions describing substrate utilization by suspended biomass. The investigation carried out looks at two important aspects of organic carbon modeling in a shallow stream: (1) it compares the importance of suspended microbial populations to the biofilm community and (2) it determines the kinetics of organic carbon uptake rate by river biofilms using an artificial stream channel. The results confirmed the dominance of attached microbial films in removing organic carbon in a shallow turbulent river. The study provided the organic carbon uptake rate (RB) and the net scour rate (RD) for the biofilms while establishing the validity of first order kinetics in a specified range of substrate concentrations, flow velocity and temperature. Mathematical models were formulated and verified under steady state conditions for the organic carbon and biomass change below a sewage outfall in a selected river system. (Author's abstract)
W84-04046

MOST RAPID BOD ASSIMILATION IN GANGA AND YAMUNA RIVERS,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Journal of Environmental Engineering, Vol. 109, No. 1, p 174-188, February, 1983. 7 Fig, 6 Tab, 16 Ref.

Descriptors: *Biochemical oxygen demand, *Fate of pollutants, *Ganga, *Ganges, *Yamuna, *India, Bioflocculation, Aeration, Dissolved oxygen, Municipal wastewater, Mathematical models, Kinetics.

During a water quality survey of the Ganga and Yamuna of the Indogangetic plain, the assimilation of biochemical oxygen demand (BOD) after the waste outfalls at the urban centers along these rivers was found to be exceedingly fast. During the two-stage BOD removal in these streams, the early reaches resulted from bioflocculation of waste colloidal matter with river water. It was found to follow a straight line law approximately a BOD rate constant (k) of as high values as 30 to 100 day-1 (base e) resulting in about 60% BOD removal in 30 min-60 min. In the later reaches, the BOD removal was found to follow the usual first order kinetics with k ranging from 1.5 to 5.5/day (base e) which are higher by an order of magnitude than the usual range of 0.2 to 0.5/day (base e). The dissolved oxygen (DO), which dropped to low values after the waste outfalls, was also found to recover in short times showing extremely fast reaeration. Such BOD exertion and reaeration have been modelled. The integrated effect of several drains releasing at an urban center has also been included in the prediction of BOD and DO. (Author's abstract)
W84-04048

SOURCES AND MOLECULAR WEIGHT OF 'DISSOLVED' ORGANIC CARBON IN AN OLIGOTROPHIC LAKE,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2H.
W84-04053

RAIN AND SNOW SCAVENGING OF HNO3 VAPOR IN THE ATMOSPHERE,
Ford Motor Co., Dearborn, MI. Research Staff.
T. Y. Chang.
Atmospheric Environment, Vol. 18, No. 1, p 191-197, 1984. 30 Ref.

Descriptors: *Rainfall, *Scavenging, *Water pollution sources, Nitrates, Precipitation, Air pollution, Acidity, Acid rain, Precipitation rate, Snow.

Wet removal coefficients for HNO3 vapor from the atmosphere by rain (in-cloud and below-cloud, washout) and snow have been derived under a number of approximations. The coefficients are parameterized in terms of precipitation rate. The coefficients represent average scavenging from large precipitation bands or frontal systems over horizontal scales of 50 km or more where there is widespread weakly ascending air motion. Because a number of approximations are involved in the derivation of these coefficients, there exist significant uncertainties in the derived expressions, particularly in the snow scavenging coefficients. The derived coefficients would be appropriate, on an interim basis, for inclusion into regional or mesoscale models which include the wet removal of HNO3 vapor. When combined with altitude-dependent precipitation rates and vertical profiles of HNO3 concentrations, these coefficients are also useful to estimate the flux of HNO3 to the earth's surface. The derived snow scavenging coefficients are consistent with those of recent measurements. Rain and snow scavenging coefficients are also consistent with recent observations of ionic composition in winter precipitation samples which indicates that snow removes HNO3 vapor more efficiently than rain. (Baker-IVI)
W84-04063

MODEL FOR SULPHATE IN STREAMWATER AT STORGAMA, SOUTHERN NORWAY,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
N. Christophersen, L. H. Dymbe, M. Johannssen, and H. M. Seip.
Ecological Modelling, Vol. 21, No. 1 and 2, p 35-61, 1983/1984. 13 Fig, 4 Tab, 39 Ref.

Descriptors: *Sulfate, *Path of pollutants, Norway, Storms, Rainfall, Runoff, Storgama, Model studies, Snowpack, Snowmelt, Seasonal variations, Streams, Telemark county.

The sulfate budget and a model for sulfate concentrations in streamwater have been established for a small, gauged catchment in Telemark county, southern Norway. The annual input roughly balances the output. The average annual flux through the catchment for four years is about 3500 mg

sulfate/sq m. Typical seasonal trends, such as the fairly stable winter concentrations and the decrease during melting, are reproduced in a model which is based on a simple reservoir hydrologic model. In the model, water-soluble sulfate accumulated in the reservoir representing the surface soils during dry periods because of dry deposition, evapotranspiration of summer rainfalls and mineralization. During wet summer periods, water-soluble sulfate is removed due to reduction adsorption. The concentration pattern during snowmelt is largely dependent on the fractionation of sulfate held by the snowpack. The model is particularly useful as a data interpretation tool. The difference between wet and dry summers is also clearly shown. A systematic discrepancy occurs in the initial phase of the snowmelt where the predicted concentrations are always too low. (Baker-IVI)
W84-04065

EFFECTS OF ACID RAIN ON WATER SUPPLIES IN THE NORTHEAST,
New England Water Works Association, Dedham, MA.
F. B. Taylor, and G. E. Symons.
American Water Works Association Journal, Vol. 76, No. 3, p 34-41, March, 1984. 4 Fig, 13 Tab, 17 Ref.

Descriptors: *Acid rain, *Public health, *Drinking water, Aquifers, Watersheds, New England, Groundwater, Surface waters, Precipitation, Corrosion, Economic factors.

Surface water and groundwater supplies were sampled in New England, and some sites in the Northeast and the Appalachians to determine the impacts of acid precipitation on drinking water, in terms of health effects in humans. During this study the adverse effects of acid rain on human health through ingestion of surface water supplies was not demonstrated, but the data show that unadjusted aluminum content in a number of supplies could be a problem to patients on kidney dialysis. Though the quantification remains to be established, it is reasonable to assign some part of the highly corrosive nature of New England waters to acidic deposition because of the poorly buffered watersheds and aquifers. Historical data, as demonstrated in the case described showed that highly aggressive waters have been encountered for a long time. A system for classifying watersheds and aquifers is proposed. (Baker-IVI)
W84-04082

FIELD MONITORING OF CHRYSOTILE ASBESTOS IN CALIFORNIA WATERS,
California Dept. of Health Services, Berkeley. Air and Industrial Hygiene Lab. Section.
S. B. Hayward.
Journal of the American Water Works Association, Vol. 76, No. 3, p 66-73, March, 1984. 9 Fig, 7 Tab, 29 Ref.

Descriptors: *Asbestos, *California, *Drinking water, Water supply, Serpentine, Watersheds, Water pollution sources, Reservoirs, Seasonal variation, Water treatment, Coagulation, Turbidity.

Asbestos contamination in sources of drinking water in the state of California is being monitored. Contamination of surface water supplies draining serpentine-containing watersheds of being stored in reservoirs in contact with serpentine deposits is usually >100 MFL and has been found to be as high as 200,000 MFL. Concentrations in water supplies draining serpentine-containing watershed exhibit seasonal variations, with the largest concentrations occurring during or just following heavy rains in the watershed. Some of the concentrations were the highest measured anywhere in the world. Asbestos was also found in groundwater taken from wells that are recharged through serpentine rock. Water treatment was found to have widely varying success in the removal of asbestos fibers. Reduction by a factor of 50,000 was observed as a result of conventional coagulation-filtration in one case. Data on treatment suggest that the percentage removal of fibers depends on the initial concentration. Asbestos concentrations have been found to correlate well with turbidity in only a few limited cases. (Moore-IVI)
W84-04087

NATIONWIDE ASSESSMENT OF URBAN RUNOFF IMPACT ON RECEIVING WATER QUALITY,
Florida Water Resources Research Center, Gainesville.
J. P. Heaney, and W. C. Huber.
Water Resources Bulletin, Vol. 20, No. 1, p 35-42, February, 1984. 2 Fig, 5 Tab, 14 Ref. EPA grant 805663.

Descriptors: *Urban runoff, *Combined sewer overflows, *Environmental effects, *Water quality, Water pollution effects, Fish kills, Beaches, Dissolved oxygen, Storm runoff.

Urban stormwater runoff has been recognized as a potential major contributor of pollution to receiving waters. However the projected high costs of control have prompted an examination of the extent to which these impacts have been documented. A nationwide search was conducted for case studies demonstrating a cause-effect linkage between urban runoff and impairment of beneficial uses in receiving waters. Documented case studies of impacts of urban runoff and combined sewer overflows on receiving water are scarce. Impacts of other discharges mask the impacts of urban runoff, and the expected impacts from urban runoff are relatively subtle. The existance of numerous definitions of the word 'impact' make it difficult to devise meaningful rankings of impacts. No clear line of demarcation exists to destinguish the urban drainage system from the receiving water, especially for small creeks and ponds. Some evidence exists that urban runoff is a cause of fish kills and beach closings. The studies of dissolved oxygen records downstream of urban areas have produced the most definitive information regarding the impact of wet weather flows. Stormwater discharges dampen the diurnal fluctuations in dissolved oxygen and can reduce the overall dissolved oxygen levels. If receiving water impacts are to be evaluated for environmental decision making, then a problem solving framework is needed. (Moore-IVI)
W84-04102

FECAL COLIFORM RELEASE FROM CATTLE FECAL DEPOSITS,
Utah State Univ., Logan. Coll. of Natural Resources.
M. Kress, and G. F. Gifford.
Water Resources Bulletin, Vol. 20, No. 1, p 61-66, February, 1984. 7 Fig, 24 Ref. OWRT project JNR 048-Utah.

Descriptors: *Feces, *Coliforms, *Cattle, *Water pollution sources, Fecal coliforms, Rainfall intensity, Bacteria.

Cowpies molded to a standard configuration and size were subjected to simulated rainfall, and the fecal coliform counts were determined using the most probable number (MPN) method of enumeration. The standard cowpie deposits were exposed to simulated rainfall once at ages 2 through 100 days. The effects of rainfall intensity and recurrent rainfall were also tested. Naturally-occurring fecal deposits were also tested to compare their results with those from the standard cowpies. A log-log regression was found to describe in peak fecal coliform release with fecal deposit age. The 100-day-old fecal deposits produced peak counts of 4,200 fecal coliform per 100 milliliters of water. This quantity of release is minimal compared to the release from fresher fecal material. Rainfall intensity had little effect on peak fecal coliform release from fecal deposits that were 2 or 10 days old. At age 20 days the effect of rainfall intensity was significant; the highest intensity gave the lowest peak counts, and the lowest intensity gave the highest peak counts. The effect of rainfall intensity appears to be related to the dryness of the fecal deposits. Peak fecal coliform counts were significantly lower when the fecal deposits were rained on more than once. This decline was thought to be produced by the loss of bacteria from the fecal deposits during the previous wettings. Standard cowpies produced a peak release regression that was not significantly different from the regression for the natural fecal deposits. Apparently, grossly manipulating the fecal deposits did not significantly change the release patterns. (Author's abstract)
W84-04105

CHEMICAL COMPOSITION OF SOFTWATER FLORIDA LAKES AND THEIR SENSITIVITY TO ACID PRECIPITATION,
Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 2H.
W84-04107

DENITRIFICATION: ITS IMPORTANCE IN A RIVER DRAINING AN INTENSIVELY CROPPED WATERSHED,
York Univ., Toronto (Ontario). Dept. of Geography.
A. R. Hill.
Agriculture, Ecosystems and Environment, Vol. 10, No. 1, p 47-62, August, 1983. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Nitrogen, *Water pollution sources, *Fate of pollutants, *Nottawasaga River, *Ontario, Fertilizers, Nitrates, Groundwater pollution, Denitrification, Sediments, Path of pollutants.

Nitrogen transport was studied during summer low flows in a 20-km reach of the Nottawasaga River (Ontario) which drains an intensively cropped sand plain which has an underlying shallow water-table aquifer. Nitrogen inputs to the river were measured on 30 days in May to October of 1977-81. These data indicated that about 38% of the daily nitrate input entered the river through ground water. The magnitude of this input is a consequence of widespread contamination of the shallow aquifer by nitrogen fertilizer. Ground water entering the river from springs and seeps near fertilized fields frequently contained more than 10 mg/l of NO3-N. Mass balance studies of nitrogen transport in the river revealed an average daily nitrate loss of 46 + or - 23 kg N. This rate of nitrate removal represented about 40% of the ground water input to the river from the sand plain. Analysis of a mass balance for total Kjeldahl nitrogen revealed an essentially balanced budget, whereas chloride showed a small daily gain of about 5%. Laboratory experiments involving the incubation of stream sediment cores and the use of the acetylene block technique suggested that the bulk of the nitrate loss during river transport was caused by denitrification in bottom sediments. (Author's abstract)
W84-04113

DISPERSION SCALE EFFECT IN MODEL CALIBRATIONS AND FIELD TRACER EXPERIMENTS,
Texas A and M Univ., College Station. Dept. of Geology.
P. A. Domenico, and G. A. Robbins.
Journal of Hydrology, Vol. 70, No. 1-4, p 123-132, 1984. 1 Fig, 1 Tab, 16 Ref.

Descriptors: *Dispersion, *Model studies, *Tracers, Groundwater pollution, Path of pollutants, Dispersivity, Model scale, Plumes.

Field tracer experiments and model calibrations indicate that the magnitude of dispersivity increases as a function of the scale at which observations are made. Calculations presented in this study suggest that some part of this scaling may be explained as an artifact of the models used. Specifically, a scaling-up of dispersivity will occur whenever an (n - 1)-dimensional model is calibrated or otherwise employed to describe an n-dimensional system. The calibrated coefficients for such models will depend not only on size of the contaminant plume or tracer experiment at the time of calibration, but will exhibit a size dependency beyond the calibration period. The magnitude of scaling appears to be sufficient to encompass the range of differences between laboratory measurements of

dispersivity and model calibrations. (Author's abstract)
W84-04146

RAPID PREDICTION OF THE EXTENSION OF POLLUTION IN SOME CASES OF EFFLUENT AND METHOD OF INJECTION (PREVISION RAPIDE DE L'EXTENSION D'UNE POLLUTION DANS QUELQUES CAS D'ECOULEMENT ET DE MODE D'INJECTION),
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
N. Crampon.
Journal of Hydrology, Vol. 70, No. 1-4, p 149-165, 1984. 4 Fig, 9 Ref.

Descriptors: *Path of pollutants, *Dispersion, Groundwater pollution, Wells, Saturated flow, Groundwater movement, Mathematical models.

The relationship between maximum concentration and longitudinal distance, independent of time, can determine the size of the area to be contaminated, under well-defined conditions of injection and flow in a saturated medium. The envelope curve for maximal concentrations is easily obtained as a function of the axial distance in nondimensional variables in the cases of one- and two-dimensional uniform flow, as well as in those of radially symmetric converging or diverging flow. Graphs providing relations between dimensionless variables are given for the following cases: (1) uniform flow with instantaneous discharge of a pollutant; measurement downstream of the injection point, no transverse dispersion; (2) uniform flow with continuous injection of a pollutant; measurement downstream of the injection point, influence of transverse dispersion included; (3) convergent radial flow towards as well; pollution caused by an instantaneous point-source at some distance; and (4) divergent radial flow from an injection point; pollution caused by instantaneous injection of a pollutant. (Author's abstract)
W84-04148

ANALYTICAL SOLUTION FOR CHEMICAL TRANSPORT WITH NONEQUILIBRIUM MASS TRANSFER, ADSORPTION AND BIOLOGICAL TRANSFORMATION,
Institut Fotosinteza, Pushchino (USSR).
E. V. Mironenko, and Ya. A. Pachepsky.
Journal of Hydrology, Vol. 70, No. 1-4, p 167-175, 1984. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Path of pollutants, *Nitrates, Denitrification, Model studies, mathematical equations, Solute transport, Sorption.

An analytical solution is presented for the set of equations describing chemical transport in soils with dispersion, presence of a stagnant liquid phase and sorption, in which the solute is involved in biological or chemical transformations. The model is used for description of nitrate transport and denitrification in a soil column. Both the case of constant input concentration of migrant and the case of a concentration pulse were considered. (Baker-IVI)
W84-04149

DISTRIBUTION, SOURCE AND EVOLUTION OF NITRATE IN A GLACIAL TILL OF SOUTHERN ALBERTA, CANADA,
Department of Agriculture, Lethbridge (Alberta).
M. J. Hendry, R. G. L. McCready, and W. D. Gould.
Journal of Hydrology, Vol. 70, No. 1-4, p 177-198, 1984. 10 Fig, 6 Tab, 43 Ref.

Descriptors: *Nitrates, *Glacial till, *Alberta, *Water pollution sources, *Groundwater pollution, Tritium, Bacteria, Denitrification.

This paper addresses the distribution, origin and controls upon nitrate in a 30-sq km area of the Interior Great Plains Region of southern Alberta, Canada. High concentrations of nitrate (>100 mg/l NO3(-)-N) occurred in several isolated enclaves below the water table in brown weathered till. Nitrate concentrations of over 300 mg/l(-)-N were encountered in groundwater samples collected from these enclaves. Low nitrate concentrations (<1.1 mg/l NO3(-)-N) were also encountered in the weathered till upgradient and downgradient of the nitrate enclaves. Groundwater samples collected from the underlying grey nonweathered till and bedrock had NO3(-)-N concentrations of <1.1 mg/l. Through the application of geochemical (NO3(-)-N and NH4(+)-N) studies, environmental isotope studies (tritium), microbial analyses (nitrifiers) and laboratory experiments, it was shown that the high nitrates found in the weathered till are the result of the oxidation of ammonium present within the tills. It is postulated that this oxidation occurred during the Holocene epoch when water tables were much lower than present-day levels (5-18 m, and 2 m below ground, respectively). Through the use of Eh measurements, the enumeration of denitrifying bacteria and laboratory experiments, the potential for denitrification was shown to exist below the present-day water table in the weathered till as well as in the nonweathered till and bedrock. Isotopic data showed that less dentrification may be occurring within the nitrate enclaves than in adjacent downgradient areas. (Author's abstract)
W84-04150

LEACHING OF ALDICARB AND THIOFANOX, AND THEIR UPTAKE IN SOILS BY SUGARBEET PLANTS,
Ghent Rijksuniversiteit (Belgium). Dept. of Crop Protection Chemistry.
W. Dejonckheere, W. Steurbaut, G. Melkebeke, and R. H. Kips.
Pesticide Science, Vol. 14, No. 2, p 99-107, April, 1983. 9 Tab, 15 Ref.

Descriptors: *Leaching, *Insecticides, *Beets, Path of pollutants, Irrigation, Aldicarb, Thiofanox, Pesticide residues.

The leaching of aldicarb and thiofanox in soils (sandy loam, silt loam and sandy clay loam), and their uptake by sugarbeet plants were studied. Three irrigation levels were maintained: half, normal and double dose. The residues were determined as the sum of the insecticidal metabolites (parent compound + sulfoxide + sulphone) for both pesticides. Leaching was greatly influenced by the amount of water added and the soil type. Under normal conditions, leaching seemed to proceed very slowly, keeping the chemicals available for uptake by the root systems for a long time. The concentration of insecticide in the leaves was highest in beets grown on sandy loam and lowest in those grown on sandy clay loam. The quantity of irrigation did not influence the residue concentration in the leaves greatly, although its influence was obvious on the total residue present (micro g per plant). Increasing the water dose always resulted in a higher total residue, and a greater plant weight. The breakdown in the soils was directly related to the water dose. The experiments show that thiofanox was more stable than aldicarb and was taken up by sugarbeet to a greater extent. (Author's abstract)
W84-04177

HERBICIDE RESIDUES IN WASTE WATERS FROM RICEFIELDS,
Cagliari Univ. (Italy). Facolta de Farmacia.
P. Cabras, P. Diana, M. Meloni, F. M. Pirisi, and R. Pirisi.
Pesticide Science, Vol. 14, No, 2, p 130-134, April, 1983. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Pesticide residues, *Herbicides, *Insecticides, *Rice, Wastewater, Water pollution sources, Pesticide residues.

The potential pollution of the ricefields by herbicides can be defined by the empirical quantity theoretical maximum concentration (TMC), which is the concentration of the herbicides in the water when their sprayed amounts are dissolved in an average depth of water (about 20 cm). The herbicides bentazone, 2,4-D, MCPA, propanil, molinate, and tiocarbazil, and the insecticide phenthoate, were applied to ricefields at rates equivalent to maximum aqueous concentrations of 0.4-2.8 mg/kg, assuming the water to be 20 cm deep. Their concentrations in water were measured by high-performance liquid chromatography. The TMC values are compared with the corresponding LC50 values for fish, the water solubility, and the minimum detectable value (MDV) achievable with the analytical technique used. All of the MDVs were at least 100 times lower than the TMC values. The TMC values are less than their water solubility. They are also lower than the LC50 values for fish, except for propanil. Residues in 162 water samples, collected from 16 ricefields, 1, 4, 7, 10, 12, 18, 21 and 120 days after the last spraying, were all below the limit of determination (0.03 mg/kg). Residues in 40 water samples taken from five drainage canals were also less than 0.03 mg/kg. (Moore-IVI)
W84-04178

5C. Effects Of Pollution

EFFECTS OF ACIDIFICATION ON THE COMPOSITION OF MOUNTAIN BROOK BIOCOENOSES, SCHLITZ STUDIES ON PRODUCTIVITY, NO. 54 (DER EINFLUSS DER VERSAUERUNG AUF DIE ZUSAMMENSETZUNG VON BERGBACHBIOZONOSEN, SCHLITZER PRODUKTIONSBIOLOGISCHE STUDIEN, 54),
Gesamthochschule Kassel (Germany, F.R.). Inst. fuer Zoologie.
U. Matthias.
Archiv fur Hydrobiologie, Suppl. 65 No. 4, p 407-483, December, 1983. 20 Fig, 16 Tab, 125 Ref.

Descriptors: *Acid rain, *Aquatic animals, *Water pollution effects, Acidity, Invertebrates, Snowmelt, Rainfall, Nitrates, Sulfates, Germany, Kassel, Brooks, Land use, Hydrogen ion concentration.

Five small brooks in the Kaufunger Wald (near Kassel, West Germany) with different degrees of acidification were chemically and biologically investigated in a wooded red stone area near Kassel within a period of two years. The acidification may be due to acid precipitation, land use changes and cation exchange in humic substances with the first cause being the suspected major one. Recorded pH-minima were always connected with times of heavy rainfall or snow melt. Eighty species of aquatic invertebrate fauna were collected in a neutral brook. In a weakly acidic brook, only 42 of these species were present, and in the strongly acid brooks with mean pH levels of 4.7, 4.5, and 4.1, only 21, 17, and 15 species were found respectively. In the Kaufunger Wald, the hydrogen ion concentration operates directly to restrict the benthic invertebrate fauna. (Baker-IVI)
W84-03506

HYDROCHEMICAL STUDIES OF THE VELIKA MORAVA RIVER AND ITS TRIBUTARIES (HYDROCHEMISCHE UNTERSUCHUNGEN DER VELIKA MORAVA UND IHRER NEBENFLUSSE),
Institute for Biological Research, Belgrade (Yugoslovia).
G. Petrovic.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 1-14, October, 1983. 16 Fig, 5 Tab, 5 Ref.

Descriptors: *Water pollution effects, *Rivers, *Sediments, Water quality, Velika Morava River, Yugoslavia, Drainage basins, Domestic wastes, Industrial wastes, Water pollution sources, Cadmium, Chromium.

Velika Morava is the largest tributary of the Danube in Serbia (Yugoslavia). Hydrochemical studies of water and sediments of the Velika Morava and its tributaries - the Kalenicka, Lugomir, Belica and Resava Rivers, as well as of its constituent rivers, the Zapadna and Juzna Morava, have been made to assess the water quality in the drainage basin of the main river. The levels of cadmium and chromium in the sediments of Velika Morava are elevated. Both industrial and domestic waste waters are impairing the quality of the waters studied to such a degree that adequate measures are needed for their protection, which

eventually would contribute to the protection of the Danube. (Baker-IVI)
W84-03509

BENTHIC ALGAE OF THE DANUBE IN THE NEIGHBOURHOOD OF VIENNA (DIE BENTHISCHEN ALGEN DER DONAU IM RAUM VON WIEN),
Biological Station, Lunz am See (Austria).
For primary bibliographic entry see Field 2H.
W84-03510

NITRIFICATION IN THE RIVERS MOSELLE AND DANUBE (ZUR NITRIFIKATION IN MOSEL UND DONAU),
D. Mueller, and V. Kirchesch.
Archiv fur Hydrobiologie, Suppl. 68, No. 1, p 63-76, October, 1983. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Nitrification, *Moselle River, *Danube River, Ammonium, Water pollution effects, Biochemical oxygen demand, Dissolved oxygen, Bacteria.

Longitudinal profiles for the BOD-5 of the River Moselle and for the BOD-7 of the Danube demonstrate that the oxygen demand caused by nitrification is an important part of the BOD. The rate of nitrification in the Danube amounts to about 0.1 mg/l/day, which is a quarter of the rate in the Moselle, though the difference between the concentrations of ammonium in the two rivers is much higher (Moselle 2 mg/l, Danube 0.2 mg/l). The rates per volume of the nitrifying bacteria attached to the river bed are calculated to be 0.6 mg/l/day for the Moselle and 0.1 mg/l/day for the Danube. The significance of nitrification in the water development and management practice for the Moselle lies in its reducing effect on the concentration of ammonium and on the oxygen consumption. The decrease in oxygen content was of special importance because of its contribution to summer fish mortality. In the Danube nitrification prevents the enrichment in ammonium. (Baker-IVI)
W84-03511

SEASONAL AND LONG-TERM CHANGES IN THE HYDROBIOLOGY OF THE LAM TSUEN RIVER, NEW TERRITORIES, HONG KONG, WITH SPECIAL REFERENCE TO BENTHIC MACROINVERTEBRATE DISTRIBUTION AND ABUNDANCE,
Hong Kong Univ. Dept. of Zoology.
D. Dudgeon.
Archiv fur Hydrobiologie, Suppl. 69, No. 1, p 55-129, January, 1984. 38 Fig, 6 Tab, 146 Ref.

Descriptors: *Benthic environment, *Seasonal variations, *Lam Tsuen River, *Hong Kong, Species distribution, Macrobenthos, Bottom sediments, Eutrophication, Invertebrates, Aquatic animals.

Water quality varied along the river, with middle and lower course sites showing signs of slight cultural eutrophication in 1976. In 1978-79, the extent of organic enrichment of the river had increased at all but two upper reach stations. Temporal variations in water quality in 1978-79 were associated with changing river discharge resulting from Hong Kong's seasonal rainfall. The number of taxa and the diversity of macrobenthic communities decreased downstream in 1976 and 1978-79 while faunal abundance showed no such trend. The effects of increased cultural eutrophication in 1978-79 were reflected by large increases in macrobenthic population densities and a general decrease in faunal diversity. Lam Tsuen River sediments showed downstream changes in physical characteristics, tending towards decreased mean grain size, increased sorting and decreased skewness and kurtosis. The patterns of macroinvertebrate zonation, and sedimentary and hydrological characteristcis of the Lam Tsuen River, can be interpreted as reflecting transfers of material (nutrients, agricultural wastes, sewage) to the aquatic habitat from the surrounding terrestrial environment. Land use patterns around the Lam Tsuen River profoundly affect aquatic communities through the medium of such transfers by altering community structure as well as the distribution and abundance of individual taxa. (Baker-IVI)
W84-03513

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF A HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM; II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM; II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),
Technische Univ., Berlin (Germany, F.R.). Inst. fuer Technischen Umweltechutz.
For primary bibliographic entry see Field 5B.
W84-03514

ECOLOGICAL CHARACTERISTICS OF LAKES IN NORTH-EASTERN POLAND VERSUS THEIR TROPHIC GRADIENT; III. CHEMISTRY OF THE WATER IN 41 LAKES,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland). Zaklad Hydrobiologii.
For primary bibliographic entry see Field 2H.
W84-03518

PRODUCTION OF A STREAM SHREDDER, PELTOPERLA MARIA (PLECOPTERA: PELTOPERLIDAE) IN DISTURBED AND UNDISTURBED HARDWOOD CATCHMENTS,
Georgia Univ., Athens. Dept. of Entomology.
J. O'Hop, J. B. Wallace, and J. D. Haefner.
Freshwater Biology, Vol. 14, No. 1, p 13-21, February, 1984. 2 Fig, 4 Tab, 36 Ref.

Descriptors: *Peltoperla maria, *Population density, *Streams, Ecosystems, Population dynamics, Catchment areas, Comparison studies, Appalachia, Insect behavior.

The average benthic density of Peltoperla maria in an undisturbed southern Appalachian stream was more than twice that of a nearby stream draining a previously clear-cut catchment in its tenth year of natural secondary succession. Peltoperla production estimates, using three methods, do not show a significant difference in production between streams draining the two catchments. This is attributed to quicker growth and slightly higher densities of larger nymphs in the disturbed stream. Production estimates for the disturbed stream ranged from 498 to 560 mg (ash free dry weight)/sq m/y while those for the undisturbed stream were 414-515 mg/sq m/y. These results reinforce the view that conclusions based solely upon numerical densities may lead to erroneous interpretations about the roles organisms play in ecosystems. Annual frass production by this shredder is about 20 times (10 g/sq m/y) the secondary production of P. maria. (Murphy-IVI)
W84-03528

LEVELS OF ORGANOCHLORINE COMPOUNDS IN AN INLAND SEAL POPULATION IN EASTERN FINLAND,
Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W84-03538

CHEMICAL AND HYDROLOGIC ASSESSMENT OF THE CALOOSAHATCHEE RIVER BASIN, LAKE OKEECHOBEE TO FRANKLIN LOCK, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03591

SOUTH JEFFERSON STREAM QUALITY ASSESSMENT PROGRAM,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W84-03654

ACID PRECIPITATION AND THE SALMON RIVER SYSTEM, TUG HILL, NEW YORK,
Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2K.
W84-03658

TUG HILL REGION: PREPARING FOR THE FUTURE.
For primary bibliographic entry see Field 6G.
W84-03660

EFFECTS OF VOLCANIC ASH AND ESTUARINE SEDIMENT ON THE EARLY LIFE HISTORY STAGES OF THE PACIFIC HERRING, CLUPEA HARENGUS PALLASI,
Oregon State Univ., Newport. Marine Science Center.
G. W. Boehlert, J. B. Morgan, and M. M. Yoklavich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-153535, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-87, Oregon State Univ., Corvallis, October, 1983. 72 p, 13 Fig, 13 Tab, 52 Ref. Project No. OWRT C-10085-V (1461) (1), Contract/Grant No. 14-34-0001-1461.

Descriptors: *Volcanic ash, Fish, *Herring, *Pacific herring, *Fish eggs, *Fish larvae, Sedimentation, *Suspended solids, *Suspended sediment, Estuaries, *Estuarine fisheries, Fisheries, *Mt. St. Helens, *Columbia River Estuary.

Potential effects of volcanic ash from Mt. St. Helens eruption upon early life history stages of Pacific herring, Clupea harengus pallasi, a species which spawns demersal eggs in the lower Columbia River estuary, were assessed and compared with effects of uncontaminated estuarine sediment. Three life stages were considered: developing eggs, yolk-sac larvae, and newly feeding larvae. Settling of ash or sediment on developing eggs at increasing suspension concentrations slowed development and caused mortalities to approach 100%. Smothering due to oxygen deprivation was more dramatic with sediment than ash. Suspensions continuously maintained throughout incubation allowed a fine layer of sediment or ash to accumulate on eggs but did not affect mortality rates and development times. Newly hatched yolk-sac larvae were not affected by 24-hour exposure to suspensions. However, high suspension concentrations caused slight increases in mortality if larvae were subsequently held in clean water; abrasion appeared to be responsible and was greater with ash than sediment. Ash and sediment suspensions affected the feeding incidence and mean number of food items consumed by feeding larvae, apparently promoting feeding by providing contrast between prey items and surrounding water. Overall, volcanic ash and estuarine sediment at environmentally realistic suspension concentrations did not severely affect herring larvae. The greatest threat appears to be egg smothering and resultant increased mortality.
W84-03669

BIOACCUMULATION MONITORING IN THE NEW YORK BIGHT USING THE BLUE MUSSEL (MYTILUS EDULIS),
Army Engineer District, New York.
S. J. Koepp, D. E. Santoro, R. Zimmer, J. E. Nadeau, and L. Ciaccio.
Final Report, New Jersey Marine Sciences Consortium, March, 1982. 41 p, 1 Fig, 73 Ref, 9 Append.

Descriptors: *Bioaccumulation, *Tissue analysis, *Ocean dumping, *Contamination, *Mussels, *Mytilus, *Chemical wastes, *Bights, Harbors, Heavy metals, Lead, Petroleum hydrocarbons, Metals, Dredging.

Concern has been expressed for the New York Bight apex, adjacent to New York Harbor, regarding the environmental impact of ocean disposal of dredged material generated during routine harbor

maintenance. Contaminants such as chlorinated hydrocarbons, toxic metals and petroleum hydrocarbons have been detected in New York Harbor's dredged material as well as the six-mile dumpsite. A bioaccumulation monitoring study was conducted using blue mussels transplanted to eight New York Bight locations. Pooled tissue samples were analyzed for total concentrations of mercury, cadmium, lead, DDT, polychlorinated biphenyls (PCBs), and No. 2 fuel oil. Stations were sampled weekly for one month, after which bi-monthly mussel collections were conducted. Some stations were damaged due to storm and human activities. Throughout the study, DDT concentrations in mussels generally remained below analytical detection for all stations. Although the three metals (mercury, cadmium and lead), PCB, and the fuel oil were consistently detected at all stations, none of these contaminants were detected in excess of existing regulatory guidelines. Bioaccumulation of mercury and cadmium was significantly greater for animals exposed at the dredged material dumpside than at both immediate and distant reference stations. Higher levels of lead were also found near the dumpsite. Although net PCB bioaccumulation occurred at all stations, the pattern of uptake was erratic over time. No. 2 fuel oil accumulation had relatively minimal uptake during initial exposure, followed by a dramatic increase in early spring. (Garrison-Omniplan)
W84-03683

CA-45 UPTAKE FROM WATER BY SNAILS (LYMNAEA VULGARIS) IN CONTROL AND DETERGENT-POLLUTED SAMPLES,
Industrial Toxicology Research Centre, Lucknow (India).
V. Misra, H. Lal, P. N. Viswanathan, and C. R. Krishna Murti.
Ecotoxicology and Environmental Safety, Vol. 8, No. 1, p 97-99, February, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Detergents, *Water pollution effects, Snails, Aquatic life, Calcium, Mollusks, Adsorption.

Synthetic detergents are among the major pollutants affecting aquatic biota. A biostatic assay method involving Ca-45 uptake into shells and tissues of snails in 72 hr was developed in efforts to follow the effect of detergent-polluted water on ecosystems. A marked decrease in the Ca-45 uptake by shells (34.43%) and tissues (37.72%) of linear alkyl benzene sulfonate-exposed animals was noted. No change in Ca-45 uptake was observed in dead shells, thereby excluding the possibiliy of passive exchange. Detergent may possibly affect the active exchange of calcium by inhibiting the activity to carbonic anhydrase and reducing the rate of shell formation. (Baker-IVI)
W84-03706

EFFECTS OF TWO HERBICIDES ON SELECTED AQUATIC BACTERIA,
Illinois Natural History Survey, Champaign.
J. Beckmann, P. Tazik, and R. Gorden.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 2, p 243-250, February, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Herbicides, *Water pollution effects, *Bacteria, Aquatic life, Fate of pollutants, Simazine, Endothall.

Herbicide applications in aquatic systems may affect bacterial populations directly by either inhibiting or stimulating the metabolism of specific functional groups or of the entire community. The effects of simazine and endothall on bacterial populations in aquatic ecosystems were evaluated. Effects of endothall and simazine on growth and respiration of common bacterial isolates obtained from aquatic ecosystems were also studied. Neither herbicide had a significant effect on total bacterial numbers present in the water column, present in sediments, or attached to macrophytes. Endothall at 5 ppm apparently slightly inhibited the respiration rate of Micrococcus sp., slightly stimulated respiration of Pseudomonas vesicularis, and had no obvious effect on the respiration rate of Bacillus sp. Simazine at 3 ppm increased the respiratory activity of four isolates. (Baker-IVI)
W84-03711

ENVIRONMENTAL ASPECTS OF THE USE OF NTA AS A DETERGENT BUILDER,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
R. Perry, P. W. W. Kirk, T. Stephenson, and J. N. Lester.
Water Research, Vol. 18, No. 3, p 255-276, 1984. 10 Fig, 185 Ref.

Descriptors: *Nitrilotriacetic acid, *Detergents, *Heavy metals, Wastewater treatment, Biodegradation, Water pollution sources, Metal speciation, Sludge disposal, Water pollution sources.

The behavior, fate and significance of the detergent builder nitrilotriacetic acid (NTA) was reviewed with particular emphasis on the removal of NTA during wastewater treatment and the effects of NTA on heavy metal solubility both during treatment and in the receiving environment. NTA removal during secondary biological treatment is subject to considerable variation, both temporal and between works as a result of changes in NTA load, temperature, water hardness and treatment process parameters. Due to such variability, effluent NTA concentrations may be sufficient to mobilize heavy metals resulting in metal contamination of receiving waters and potable waters, particularly in areas of low effluent dilution and high water re-use. Removal of NTA during primary sedimentation and septic tank treatment occurs primarily by adsorption to the sludge solids while removal in anaerobic sludge digestion is subject to operational characteristics of the treatment works. Disposal of NTA contaminated sludge to land may contaminate groundwaters and affect heavy metal speciation, while the disposal of contaminated sludge or sewage to the sea may result in toxic algal blooms, in addition to the effects on metal speciation. (Baker-IVI)
W84-03730

EXCHANGE OF OXYGEN AND CARBON DIOXIDE ACROSS THE WATER SURFACE DURING ALGAL BLOOMS IN A POND,
Tokyo Univ. (Japan). Dept. of Chemical Engineering.
H. Nishimura, M. Nakajima, and M. Kumagai.
Water Research, Vol. 18, No. 3, p 345-350, 1984. 8 Fig, 18 Ref.

Descriptors: *Eutrophication, *Oxygen, *Carbon dioxide, Ponds, Algal growth, Algae, Gas exchange, Chlorophyll-a.

During algal blooms, total inorganic carbon (TCO2) is rapidly consumed through high photosynthetic activity of algae, and is often depleted to a trace in surface waters. Under these conditions, TCO2 may limit the algal growth rate. Measurements were taken of oxygen and total carbon dioxide, pH and chlorophyll-a as they related to the exchange of oxygen and carbon dioxide across the water surface of a pond during algal blooms. Light and dark bottles were also used to study the production and consumption rates of oxygen due to biological activity. Algal blooms occurred twice during the 22 day study period. The trajectory on the phase plane showing the time changes in concentration of oxygen and total carbon dioxide made a clockwise, converging loop. To distinguish the role of gas exchange from that of deposits, a new concept and quantity called total oxygen (TO2) is proposed. TO2 is the sum of the concentrations of O2 and TCO2. The total amount of TO2 decreased during the production period and increased during the decomposition period. This was due to the difference between O2 and TCO2. During the production period, 60% of produced O2 was lost to the atmosphere and 20% of consumed TCO2 was supplied from the atmosphere. During the decomposition period, 80% of consumed O2 was supplied, and 35% of produced TCO2 was lost. (Baker-IVI)
W84-03737

UPTAKE, DISTRIBUTION, METABOLISM AND CLEARANCE OF CHLORDECONE BY CHANNEL CATFISH (ICTALURUS PUNCTATUS),
Virginia Inst. of Marine Science, Gloucester Point.
P. A. van Veld, M. E. Bender, and M. H. Roberts, Jr.
Aquatic Toxicology, Vol. 5, No. 1, p 33-49, February, 1984. 2 Fig, 6 Tab, 38 Ref.

Descriptors: *Pesticides, *Water pollution effects, *Catfish, Fish, Chlordecone, Kepone, Adsorption, Accumulation, Metabolism, Path of pollutants.

Potential health and environmental hazard have arisen for the discharge of chlordecone (Kepone) into the upper tidal portion of the James River. Channel catfish were exposed to a C-14 labeled chlordecone-contaminated diet for 90 days, followed by a chlordecone-free diet for 30 days. Uptake and clearance rate constants were 0.237 and 0.080/day, respectively. The half-life of chlordecone in the fish was 8.7 days. The dietary accumulation factor defined as the equilibrium concentration of pesticide in fish/daily dietary dosage level was 3.0. The blood and brain contained the highest concentrations of chlordecone. Lowest concentrations were in the mesenteric adipose and carcass. Chlordecone may be eliminated with bile via the intestinal contents. It may also be excreted across the gills and sloughed off with epidermal mucus. Urinary excretion is negligible. The catfish can reduce chlordecone to chlordecone alcohol. Metabolic transformation of chlordecone by aquatic organisms has not previously been reported. Enzymatic digestion of bile with beta-glucuronidase did not significantly affect the recovery of chlordecone or chlordecone alcohol. (Baker-IVI)
W84-03742

ABUNDANCE, BIOMASS AND DIVERSITY OF BENTHIC MACRO-INVERTEBRATES IN A WESTERN CAPE RIVER, SOUTH AFRICA,
Cape Town Univ. (South Africa). Percy Fitzpatrick Inst. of African Ornithology.
For primary bibliographic entry see Field 2H.
W84-03751

COMMUNITY WATERBORNE GASTROENTERITIS OUTBREAK: EVIDENCE FOR ROTAVIRUS AS THE AGENT,
Colorado Dept. of Health, Denver. Disease Control and Epidemiology Div.
R. S. Hopkins, G. B. Gaspard, F. P. Williams, Jr., R. J. Karlin, and G. Cukor.
American Journal of Public Health, Vol. 74, No. 3, p 263-265, March, 1984. 1 Tab, 16 Ref. EPA contract CR-80880101.

Descriptors: *Public health, *Drinking water, *Water quality control, *Gastroenteritis, *Rotaviruses, Chlorination, Disinfection, Wastewater, Water pollution effects, Viruses, Eagle-Vail, Avon, Colorado.

A community waterborne nonbacterial gastroenteritis outbreak occurred in Eagle-Vail and Avon, Colorado in March of 1981. Eagle-Vail and Avon shared a common water supply and distribution system. Illness was statistically associated with water consumption. Five of seven persons associated with the outbreak were infected with rotavirus. Bacterial pathogens, Giardia lambia, and Norwalk virus were excluded as possible agents. Four coincident physical factors probably contributed to the outbreak: a sewage treatment plant was discharging sludge solids into Gore Creek, upstream from the water intake for the Eagle-Vail water treatment plant; there was no chemical or physical pretreatment of water prior to filtration at the plant; severely channeled filter beds were found in the water treatment plant; and the Eagle-Vail chlorinator failed on March 4, 1981. This chlorinator was the only effective barrier between the toilets of Vail and the watertaps of Eagle-Vail and Avon. (Baker-IVI)
W84-03754

EVALUATION OF CHANGES IN A LARGE OLIGOTROPHIC WILDERNESS PARK LAKE EXPOSED TO MINE TAILING EFFLUENT FOR 14 YEARS: THE PHYTOPLANKTON,

Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, and N. Munteanu.

Environmental Pollution (Series A), Vol. 33, No. 1, p 39-62, 1984. 4 Fig, 5 Tab, 38 Ref.

Descriptors: *Water pollution effects, *Mine wastes, *Phytoplankton, Oligtrophic lakes, Buttle Lake, Upper Campbell Lake, Mercury, Zinc, Copper, Cadmium, Lead, Diatoms, Desmids, Upper Quinsam Lake, British Columbia.

Buttle Lake lies at the head of the extensive Campbell River watershed. Much of the drainage basin is located within the boundaries of Strathcona Provincial Wilderness Park. The lake connects by a narrow passage with Upper Campbell Lake which feeds into Lower Campbell Lake. Both Upper and Lower Campbell Lakes were formed from a river system by the construction of three dams. Mine tailings from a concentrator have been fed into Buttle Lake since 1967 via a submerged outfall. Data from phytoplankton samples collected in 1966, 1967, and 1968 were compared with data collected in 1980 and 1981. While the nutrient levels do not appear responsible, the levels of heavy metal concentrations have increased and reached values substantially above background levels in a control lake, Upper Quinsam Lake. Organisms intolerant of heavy metals, including several diatom and desmid species, have either disappeared or become extremely rare. Increases in abundance of Navicula cryptocephala, Synedra acus, S. ulna, Cyclotella bodanica and C. glomerata have been noted as these species are tolerant of the metal concentrations. These changes have resulted in a decrease in species diversity and species number. (Baker-IVI)
W84-03755

EFFECTS OF TRICHLOROETHYLENE ON THE POPULATION DYNAMICS OF PHYTO- AND ZOOPLANKTON IN COMPARTMENTS OF A NATURAL POND,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
J. P. Lay, W. Schauerte, and W. Klein.

Environmental Pollution (Series A), Vol. 33, No. 1, p 75-91, 1984. 6 Fig, 2 Tab, 21 Ref. Commission of the European Communities Contract No. 187-77-1 ENV D.

Descriptors: *Zooplankton, *Population dynamics, *Water pollution effects, Ponds, Trichloroethylene, Organic compounds, Trophic levels.

Single doses (110 and 25 mg/liter) of trichloroethylene (Tri) were applied in replicates to the water of compartments of a natural pond. In comparison to two control compartments and the surrounding water, the disappearance rates of Tri and the effects on the biota were measured. Disappearance rates of Tri from the aquatic phase were equal for both chemical concentrations and were determined at a half-life of 2.7 days. Both initial concentrations of Tri were highly toxic to Daphnia and caused a decrease (low dose) or elimination (high dose) of this species shortly after application. Following Tri application the phytoplankton community changes from high to low diversity. Relative abundance and the absolute number of all phytoplankton individuals counted increased, mostly in the high-dosed compartments. Autotrophic phytoplankton species were eliminated in part, heterotrophic ones significantly increased. Physicochemical properties of the water were not significantly influenced by the treatment. (Baker-IVI)
W84-03756

RECOVERY OF DDT, KEPONE, AND PERMETHRIN ADDED TO SOIL AND SEDIMENT SUSPENSIONS INCUBATED UNDER CONTROLLED REDOX POTENTIAL AND PH CONDITIONS,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. P. Gambrell, C. N. Reddy, V. Collard, G. Green, and W. H. Patrick, Jr.

Journal Water Pollution Control Federation, Vol. 56, No. 2, p 174-182, February, 1984. 8 Fig, 2 Tab, 15 Ref. EPA Grant R804940-01-1.

Descriptors: *Pesticides, *Fate of pollutants, *Environmental effects, Permethrin, DDT, Kepone, Chemical reactions, Organic compounds.

The persistence and fate of organic pesticides and therefore their environmental impact differs widely under various physicochemical conditions. Permethrin can be strongly affected by physicochemical conditions of the environment during the course of a few weeks to a few months. Strongly reducing conditions characteristic of sediments enhance the persistence of Permethrin. The effects of pH on recovery of DDT from amended sediment material were negligible at each of the four redox potential levels studied. Redox potential treatments, however, greatly affected DDT recovery. At all redox potentials used there was no evidence of any reduction in Kepone levels during the 52 day study. At pH levels of 5.0 and 8.0 there was some evidence of a decrease in Kepone concentrations toward the end of incubation (51 and 70 days, respectively), but any degradation, if it occurred, was masked by experimental variability encountered in the incubation conducted at these two pH levels. At all pH levels, there was no good indication that oxidation-reduction conditions affected Kepone degradation. Strongly reduced environs of many sensitive benthic species favor some increase in the persistence of residues that may adversely affect these populations. (Baker-IVI)
W84-03795

MEASUREMENT OF BENTHAL OXYGEN DEMAND IN THE HOUSTON SHIP CHANNEL,

Espey, Huston and Associates, Inc., Austin, TX.
G. H. Ward, Jr.

Journal Water Pollution Control Federation, Vol. 56, No. 2, p 183-191, February, 1984. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Benthos, *Oxygen demand, *Harbors, *Houston Ship Channel, Texas, Channels, Respirometer, San Jacinto River, Turning Basin, Temperature effects, Water pollution effects.

The Houston Ship Canal is a dredged canal from the entrance of Galveston Bay to the Port of Houston within the San Jacinto River System across the bay. The upper reach is highly developed, and includes several municipal treatment plants and the bulk of the Houston petrochemical complex. There is a substantial wastewater return in this reach and it is a region of consistently poor water quality. Respirometers developed in this study seem to be a useful method for direct measurement of the potential oxygen demand of Houston Ship Channel sediments. The homogenate BOD6 (HBOD6) test appears to be a satisfactory, economical indicator of large scale, intensive surveys of benthal oxygen demand. The potential benthal oxygen demand varied from 0.7 to 4.2 g/sq m/day, generally increasing with distance up the channel from the San Jacinto confluence toward the Turning Basin. Nitrification did not play any role in the oxygen depletion of samples in this study. The addition of methylene blue produced no systematic alteration in benthal oxygen demand. (Baker-IVI)
W84-03796

MERCURY AND POLYCHLORINATED BIPHENYLS IN STRIPED BASS (MORONE SAXATILIS) FROM TWO NOVA SCOTIA RIVERS,

Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, B. M. Jessop, J. Coffin, and D. A. Swetnam.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 15-23, January, 1984. 1 Fig, 5 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Bass, *Annapolis River, *Shubenacadie River, *Nova Scotia, *Mercury, *Polychlorinated biphenyls, Organic compounds, Heavy metals, Toxicity, Fisheries.

The striped bass fishery in the Annapolis and Shubenacadie Rivers of Nova Scotia is of sport and commercial importance. In recent years, the striped bass have not reproduced successfully in the Annapolis River, whereas they have no recruitment problem in Shubenacadie River. Striped bass were obtained from the angling fishery in the Annapolis River and from both angling and commercial fisheries of the Shubenacadie River in Nova Scotia, Canada. Analyses were performed for mercury content in four tissues and for PCBs in two tissues. The average mercury concentrations in the muscle, liver, kidney, and gonad of 3.9 kg fish from the Annapolis River were 0.77, 0.79, 0.26, and 0.07 micrograms/g, respectively. Corresponding values for the 1.5 kg fish from the Shubenacadie River were 0.51, 0.27, 0.24, and 0.06 micrograms/g. PCB concentrations in the muscle tissues of fish from Annapolis and Shubenacadie Rivers are 0.02 and 0.01 micrograms/g, respectively, while the concentrations in gonads are 1.4 and 0.04 micrograms/g. The observed lack of stock recruitment of striped bass in the Annapolis River may be related to high PCB concentrations in the gonad tissues. (Baker-IVI)
W84-03828

VARIATIONS IN SURFACE WATER PH WITH CHANGES IN SULPHUR DEPOSITION,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
H. M. Seip, and S. Rustad.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 217-223, January, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Acidity, *Lakes, *Acid rain, *Hydrogen ion concentration, Precipitation, Sulfates, Sulfur, Water pollution sources, Aluminum, Birkenes catchment, Norway.

The effects on surface water acidity brought about by a doubling of the sulfate concentration in runoff are considered. A very simple two reservoir hydrological model was used in the calculations. The upper reservoir supplies quickflow and can be thought of as water mainly in contact with upper soil horizons. The lower reservoir provides the base flow. It was found to be a useful approximation for the Birkenes catchment in southernmost Norway, but this is not necessarily true for most other catchments. A possible refinement of this approach would call for inclusion of other substances. Aluminum species and organic acids would give increased buffering intensities. Doubling of the sulfate concentrations in the runoff in this study may in some cases give pH decreases of 0.7 to 1.0 units or even more, from about 6 to about 5, assuming no changes in soil properties, such as base saturation, occurred. (Baker-IVI)
W84-03833

SYNERGISTIC EFFECTS OF HEAVY METAL POLLUTANTS ON SENESCENCE IN SUBMERGED AQUATIC PLANTS,

Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
S. Jana, and M. A. Choudhuri.

Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 351-357, January, 1984. 4 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Heavy metals, *Plant growth, Mercuric chloride, Lead acetate, Cadmium chloride, Cupric sulfate, Aquatic plants, Potamogeton, Vallisneria, Hydrilla, Bioindicators.

Water pollution by industrial wastes containing compounds of various heavy metal pollutants disturbs the vegetation in aquatic habitats. The sensitivity to a specific combination of toxic concentrations of heavy metal pollutants may differ for different species and it may be possible to exploit the differences in sensitivity to select indicator species for water pollution. The effects of many combinations of toxic concentrations of heavy metal pollutants, viz., mercuric chloride, lead acetate, cadmium chloride and cupric sulfate, on the

senescence of isolated mature leaves of submerged aquatic plants, Potamogeton pectinatus L., Vallisneria spiralis L., and Hydrilla verticillata (L.f.) Royle were studied. All of the combinations of heavy metal pollutants caused senescence in all three species by decreasing chlorophyll, DNA, RNA, protein and dry wt, and increasing free amino acid, tissue permeability, the activities of protease and RNase, and the ratio of acid to alkaline pyrophosphatase activity over control values. The effects were highest in Potamogeton and lowest in Hydrilla. The degree of senescence in the three submerged plants by combinations of toxic concentrations of heavy metal pollutants is much higher due to synergism than that by individual heavy metal pollutants. (Murphy-IVI)
W84-03837

ALTERATIONS IN CARBON FIXATION DURING POWER PLANT ENTRAINMENT OF ESTUARINE PHYTOPLANKTON,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
K. G. Sellner, M. E. Kachur, and L. Lyons.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 359-374, January, 1984. 10 Fig, 5 Tab, 18 Ref.

Descriptors: *Powerplants, *Phytoplankton, *Carbon fixation, *Entrainment, Phytoplankton population, Population densities, Dinoflagellates, Diatoms, Carbon, Estuarine environment, Estuaries.

The entrainment of estuarine waters in the cooling units of the Calvert Cliffs Nuclear Power Plant resulted in elevated productivities in June and reductions in C fixation rates for the total phytoplankton assemblages in July through September. In the latter 3 months, the passage of Bay water through the plant was accompanied by a decline in the photosynthetic activity of the microflagellate, Cryptomonas acuta. Phytosynthetic rates of the diatom Cyclotella and Thalassionema and the dinoflagellate Prorocentrum were not significantly altered by passage through the power plant. Assuming other representatives of each phyla respond in a similar manner, depressed phytoplankton productivity in entrained Bay waters would be expected when flagellates (as unidentified microflagellates and cryptophytes) dominate the phytoplankton assemblage and the entrainment temperature exceeds 30 degrees C. (Baker-IVI)
W84-03838

ENVIRONMENTAL FECAL POLLUTION AND CONCENTRATION POWER OF THE CLAM CHAMELEA GALLINA,
Istituto Superiore di Sanita, Rome (Italy).
L. Volterra, G. Piccininno, E. Palliola, F. A. Aulicino, and M. Gianfranceschi.
Water, Air, and Soil Pollution, Vol. 21, No. 1-4, p 415-424, January, 1984. 4 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Clams, *Bacteria, Microorganisms, Sewage bacteria, Wastewater, Italy.

Hygienic conditions of a commercially important clam, Chamelea (Venus) gallina, widely distributed along the Italian coasts were examined, with particular interest paid to whether these clams, inside their valves, accumulate microorganisms and pathogens which are present in marine sediments, directly carried into the sea by sewers, indirectly by rivers and canals. The habitat of C. gallinas is the sediment of shallow waters, from 4 to 6 m. In Italy, these depths may be located at about 200 up to 1000 m from the coastline. Five clam beds have been simultaneously surveyed, collecting samples of water, sediment and mollusks. Four extensive clam banks in the Adriatic sea (Chioggia, Goro, Rimini, Cupra Marittima) and a bank recently discovered in the Tyrrhenian sea at Caprolace were sampled. Total coliforms, fecal coliforms, and fecal streptococci have been analyzed. Results indicate that this shellfish does not seem to accumulate enteric bacteria in spite of the microbial contamination of water and sediment. (Baker-IVI)
W84-03840

EFFECTS OF VOLCANIC ASH ON THE BENTHIC ENVIRONMENT OF A MOUNTAIN STREAM, NORTHERN IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
S. A. Frenzel.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $4.75 in paper copy, $3.50 in microfiche. USGS Water-Resources Investigation Reports 82-4106, Jan. 1983. 32 p, 6 Fig, 6 Tab, 26 Ref.

Descriptors: *Stream, *Environment, Habitats, *Water quality, Benthos, *Sediments, *Idaho, Big Creek, Gedney Creek, Volcanic ash.

The May 18, 1980, eruption of Mount St. Helens deposited about 15 millimeters of volcanic ash on the Big Creek basin in northern Idaho. Much of the uncompacted ash remained on hillsides a year after the eruption. Physical and chemical analyses of water samples from Big Creek collected from December 1980 to December 1981 showed no anomalies attributable to ash. Qualitative collections showed benthic invertebrates to be abundant and diverse in Big Creek. Experiments conducted in an unimpacted mountain stream revealed a small quantity of volcanic ash may be beneficial not detrimental to invertebrate communities. Benthic invertebrates were most abundant on ash-covered artificial substrates, with detritovores dominating the communities on all substrates. (USGS)
W84-03854

POLLUTED GROUNDWATER CLEARLY A PROBLEM, BUT FEW AGREE ON EXTENT OR SOLUTION,
L. Mosher.
National Journal, Vol. 16, No. 5, p 223-225, February, 1984.

Descriptors: *Groundwater pollution, *Federal jurisdiction, Environmental Protection Agency, Management, Political aspects, Water pollution sources, Land use, Waste dumps.

Contamination threatens the underground water supply of the United States. A chief source of the pollution is land-related, being the runoff from farms and cities, which contains a rich brew of synthetic organic toxic chemicals, most of which do not break down in the ground. Regulating land use is primarily a state responsibility that the federal government cannot directly interfere with. After a change in leadership at the EPA last May, a revision of that department's approach to groundwater pollution control was expected. Under a new plan, states are given the primary responsibility to protect groundwater, but the agency would attempt to use the 1976 Toxic Substances Control Act to regulate underground storage tanks, which it considers a major contamination course. Three classes of groundwater would be distinguished, each with its own level of protection required. Some have expressed disappointment with the new plan, indicating it is little more than a public relations move. One impoundment study reportedly found 180,973 waste ponds around the country, almost half of which were over aquifers, and only 30% of which have protective liners. (Baker-IVI)
W84-03869

FATE AND EFFECTS OF ATRAZINE IN SMALL AQUATIC MICROCOSMS,
Environmental Research Lab., Athens, GA.
D. L. Brockway, P. D. Smith, and F. E. Stancil.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 345-353, March, 1984. 4 Fig, 10 Ref.

Descriptors: *Water pollution effects, *Herbicides, Atrazine, Aquatic life, Organic compounds, Agricultural chemicals, Fate of pollutants.

The objectives of this study were to determine the fate and effects of atrazine on small laboratory microcosms, to evaluate the resilience of the systems after removal of the atrazine, and to compare the responses of different types of test systems to the herbicide. This study was carried out with mixed biota communities in either continuous-flow aquaria or static beakers. Atrazine concentrations of 0, 0.5, 5, and 50 micro g/l were introduced into the continuous-flow aquaria. The experiments in the static beakers tested concentrations of 0 to 5000 micro g/l. The degradation and sorption of atrazine was very low in aquatic systems. Atrazine had a negative impact on primary producers at and above a concentration of 50 micrograms/L and possibly below. These effects are expressed best in oxygen production and dissolved nitrate in the systems. The small static systems are able to furnish results similar to those of larger more complex systems, particularly for quick response parameters. (Baker-IVI)
W84-03878

EFFECTS OF CRUDE DUBAI OIL ON SALMO GAIRDNERI RICH. AND CARASSIUS AURATUS L.,
Milan Univ. (Italy). Sezione di Ecologia.
M. C. Ramusino, R. Dellavedova, and D. Zanzottera.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 3, p 368-376, March, 1984. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Water pollution effects, *Oil spills, *Fish, Toxicity, Po River, Italy, Dubai oil, Organic compounds, Carassius, Salmo.

About 663 tons of crude Dubai oil poured into the river Po, the largest Italian river in 1980 as a result of a burst oil pipeline. Laboratory tests were carried out to identify the lethal concentrations and the concentration threshold value (below which mortality does not occur) for crude Dubai oil. Tests on Carassius auratus, treated with Dubai crude undiluted, resulted in a 48 hr LC50 of 19.89 ml/L. In tests with the water soluble fraction (WSF) of crude Dubai, an initial phase of acute toxicity was present during which mortalities occurred. However, for those animals who survived this initial phase, complete recovery was apparent. This suggests the presence of a fairly toxic volatile component which causes the acute initial effects and then evaporates. Tests using Salmo gairdneri indicate that this organism is extremely sensitive to this form of pollution. Even so, differences were evident in the response to crude oil and to its WSF. (Baker-IVI)
W84-03879

LEAF LITTER BREAKDOWN IN STREAMS RECEIVING TREATED AND UNTREATED METAL MINE DRAINAGE,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
L. J. Gray, and J. V. Ward.
Environment International, Vol. 9, No. 2, p 135-138, 1983. 2 Fig, 14 Ref.

Descriptors: *Litter, *Mine drainage, Organic matter, Streams, Colorado, Iron, Metals, Decomposition, Water pollution effects.

Because of its importance in the flow of energy in streams, leaf decomposition provides an ecosystem-level measure of pollution effects. Rates of alder leaf decomposition were used as a measure of effects of untreated and treated acid mine drainge on two Colorado mountain streams. The two study streams were Kerber Creek, a third-order tributary of San Luis Creek, and Coal Creek, a third-order tributary of the Slate River. Untreated mine effluents had low pH and high concentrations of metals, particularly iron. Deposition of ferric hydroxide on leaf surfaces inhibited colonization by decomposers, such as fungi and aquatic insects, and thus little leaf breakdown occurred. Treated effluents had improved water quality (basic pH, low metal concentrations), but suspended flocs released by the treatment process buried leaves and reduced consumer activity. The rate of leaf breakdown was not significantly different from the rate with untreated effluents. Thus improvement in water quality alone was insufficient to restore this important pathway of energy flow in headwater streams. (Baker-IVI)
W84-03889

TCDD DISTRIBUTION IN THE SPRING RIVER, SOUTHWESTERN MISSOURI,
Environmental Protection Agency, Kansas City, MO. Region VII.
R. D. Kleopfer, and J. Zirschky.
Environment International, Vol. 9, No. 4, p 249-253, 1983. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Spring River, *Missouri, *Fish, *Sediments, *TCDD, Dioxins, Biological magnification, Industrial wastes, Waste disposal.

The waste management practices of a chemical company (no longer in business) created several disposal sites containing materials contaminated with TCDD, 2,3,7,8-tetrachlorodibenzo-p-dioxin. The facility manufactured hexachlorophene from tetrachlorobenzene with 2,4,5-trichlorophenol (TCP) produced as an intermediate. TCDD was formed as an unwanted trace contaminant of the TCP. A sampling survey of the Spring River, which drains the disposal sites, was conducted to determine if TCDD contamination had occurred. Levels detected in the upper reaches of the river tend to indicate that the contamination of the river has resulted from the waste management practices of the former company. Fish contamination above the point in the stream where pollution could enter the water could be explained by migration of the fishes. Two dams near Carthage, MO were expected to prevent sediment migration beyond that point and thus limit fish contamination to areas upstream of the dams. Contaminated fish were found for a distance of at least 21 miles beyond the dams, which were not physical barriers to fish movement in either direction. Bioconcentration of extremely low levels of TCDD from the aqueous phase may also explain the extent of the contamination. The detection limits were not sufficient to determine the sediment TCDD concentration in the river. TCDD was only found in sediments immediately downstream of the former manufacturing facility at 12 ng/kg. (Baker-IVI)
W84-03891

EVALUATING THE CONSTRAINTS OF TEMPERATURE, ACTIVITY AND CONSUMPTION ON GROWTH OF LARGEMOUTH BASS,
Wisconsin Univ.-Madison. Lab. of Limnology.
J. A. Rice, J. E. Breck, S. M. Bartell, and J. F. Kitchell.
Environmental Biology of Fishes, Vol. 9, No. 3/4, p 263-275, 1983. 9 Fig, 1 Tab, 42 Ref. Savannah River Ecology Laboratory project 18449; Oak Ridge Associated Univ. Travel contract T-289; EPA and Department of Energy contract EPA-78-D-X0290; Univ. of Georgia and Department of Energy contract EY-79-A-09-0943.

Descriptors: *Bass, *Growth, Temperature effects, Fish diets, Bioenergetics, Fish behavior, Thermal pollution, Model studies, Growth model, Simulation analysis, Par Pond, South Carolina.

Growth represents a complex response to a variety of environmental factors. Bioenergetics modeling is an efficient means of evaluating the relative importance of these variables. A bioenergetics model for largemouth bass (Micropterus salmoides) simulates growth as a function of body size, temperature, activity and consumption level . The model is applied to bass in Par Pond, South Carolina, a reservoir receiving heated effluent, to investigate seasonal changes in condition factor. Previous authors have suggested that these changes occur due to bioenergetic constraints, primarily the effects of heated effluent on metabolic rate. Model simulations were used to evaluate the hypotheses that seasonal changes in condition factor were caused by the heated effluent, seasonally variable activity, seasonally variable consumption, or reproductive costs. Results indicate that temperature is not directly responsible for the seasonal changes in condition factor. Bass moderate the influence of the heated effluent via behavioral thermoregulation. Activity is not a major factor, and spawning weight-loss can account for only a small portion of the observed variation. However, the pattern of seasonal changes in body condition may be adequately explained by seasonal variations in consumption. The patterns of consumption rate and/or prey availability suggested by model simulations represent testable hypotheses. (Murphy-IVI)
W84-03895

ACIDIC PRECIPITATION EFFECTS ON CROPS: A REVIEW AND ANALYSIS OF RESEARCH,
Argonne National Lab., IL.
P. M. Irving.
Journal of Environmental Quality, Vol. 12, No. 4, p 442-453, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Acid rain, *Literature review, Environmental effects, Crop yield, Air pollution effects, Air pollution, Deposition, Simulated rain, Acidic deposition.

For more than a century it has been known that vegetative growth is affected by the products of fossil fuel combustion. Recently, the acidic deposition phenomenon has gained increasing attention, especially when implicated as a factor responsible for economic loss. Research has been directed toward quantification of effects; however, limitations in the design of many crop studies restricts the usefulness and applicability of the results. Acidic deposition varies in a number of ways that may affect crop yield (i.e., level of acidity, amount and intensity of rain, S and N doses). The responses of these variables may be nonlinear. To allow comparisons of published acid precipitation effects research, calculations for this review were made (based on information in the literature or from personal communication) to describe the experimental conditions, the various dose parameters, and the responses in comparable units for each investigation. The majority of crop species studied in field and controlled environment experiments exhibited no effect on growth nor yield as a result of simulated acidic rain. The growth and yield of some crops, however, was negatively affected by acidic rain; others exhibited a positive response. This analysis of the current literature concludes that the effects of acidic precipitation on crops appear to be minimal and that when responses are observed, they may be positive or negative. More complex experimental designs and analyses may be necessary in order to examine and describe the possible subtle responses of agricultural systems to acidic precipitation. (Author's abstract)
W84-03925

EFFECTS OF ACIDITY AND ALKALINITY ON THE STABILITY OF AMIDOHYDROLASES IN FRESHWATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. T. Frankenberger, Jr., and A. L. Page.
Journal of Environmental Quality, Vol. 12, No. 4, p 459-462, 1983. 5 Fig, 1 Tab, 13 Ref.

Descriptors: *Acidic water, *Alkalinity, *Amide-N, *Enzymatic hydrolysis, L-asparaginase, L-glutaminase, Amidase, Urease, Hydrogen ion concentration, Lakes, Cycling nutrients, Organic compounds, Microbial degradation.

The influence of acidity and alkalinity on the enzymatic hydrolysis of amide-N in the aquatic system was investigated by determining the stability of L-asparaginase (EC (Enzyme Commission) 3.5.1.1.), L-glutaminase (EC 3.5.1.2.), and amidase (EC 3.5.1.4.), and urease (EC 3.5.1.5.) with respect to pH in three freshwater lakes. The water samples were first incubated at the indicated buffer pH (1-13) for 24 h; then each enzyme was assayed at its optional pH (pHopt) under standardized conditions. L-Asparaginase retained essentially 100% of its activity within the pH range of 6-7 in Lake Evans and Lake Matthews, and 5-7 in Lake Perris. L-Glutaminase was active between pH 6 and 7 in the water samples surveyed. Amidase remained completely active at pH ranges of 4-8 in Lake Evans, 4-7 in Lake Matthews, and 5-8 in Lake Perris. Urease remained active over a broad pH range of 5-9 in Lake Evans, 5-8 in Lake Matthews, and 4-8 in Lake Perris. There was a progressive loss in enzymatic activity below and above these pH ranges. The results suggest that the decline in aquatic amidohydrolase activities in relation to the pH-profile near their pHopt was caused by a reversible reaction involving the ionization or deionization of functional groups of the active center of the protein, but under highly acidic or alkaline conditions (pH < 4 to > 9) the reduced activity appears to be due to irreversible inactivation of the enzyme. (Author's abstract)
W84-03926

RESPONSE OF SOYBEANS TO SIMULATED ACID RAIN IN THE FIELD,
North Carolina State Univ. at Raleigh. Dept. of Plant Pathology.
A. S. Heagle, R. B. Philbeck, P. F. Brewer, and R. E. Ferrell.
Journal of Environmental Quality, Vol. 12, No. 4, p 538-543, 1983. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Ecological effects, *Soybeans, *Simulated rainfall, *Acid rain, Crop yield, Soil chemistry, Hydrogen ion concentration, Rhizobium nodulation, Nematodes.

Soybeans, Glycine max (L.) Merr, 'Davis', were grown in the field during 1979 and 1980 to determine effects of semiweekly applications of simulated rain at different acidity levels in addition to ambient rain on foliage, growth, yield, Rhizobium nodulation, soil chemistry, and soil nematode populations. Plants were exposed twice weekly to 0.74 cm (1979) or 0.85 cm (1980) of simulated rain at pH levels of 5.5, 4.0, 3.2, or 2.8 in 1979 and 5.4, 4.1, 3.2, or 2.4 in 1980. There were six 3-sq m plots (replicates) for each pH level. Simulated rain at pH 2.8 or 2.4 caused small amounts of foliar injury evident as bifacial white or tan lesions primarily on young leaves. However, plant growth, pod yield, foliar elemental content, seed protein content, seed oil content, Rhizobium nodulation of roots, and populations of parasitic nematodes were not affected. Soil analyses were performed before, midway through, and after each season. Trends toward lower soil pH, and less Ca, Mg, and K occurred with increased acidity of simulated rain. These effects were statistically significant only for soil pH, Mg, and K at treatment pH 2.4. Possible effects of ambient rain at current pH levels on agricultural soils are likely to require long-term deposition. (Murphy-IVI)
W84-03932

EFFECT OF FOUR TERRESTRIAL HERBICIDES ON THE PRODUCTIVITY OF ARTIFICIAL STREAM ALGAL COMMUNITIES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
R. J. Kosinski, and M. G. Merkle.
Journal of Environmental Quality, Vol. 13, No. 1, p 75-82, 1984. 4 Fig, 2 Tab, 54 Ref. EPA grant 807978-01.

Descriptors: *Ecological effects, *Herbicides, *Algae, *Artificial streams, Streams, Atrazine, Trifluralin, Monosodium methanearsonate, Paraquat, Water pollution, Primary productivity.

Artificial streams containing algal communities derived from a spring and an agriculturally impacted stream were used to assess the effect of 0.1, 1, and 10 mg/kg atrazine 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, trifluralin (alpha, alpha, alpha-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), MSMA (monosodium methanearsonate), and paraquat (1,1'-dimethyl-4,4'-bipyridylium cation) on the productivity (photosynthesis and respiration) of stream algae. Algae of streams receiving runoff from agricultural lands are an obvious nontarget community. The importance of induced resistance to the herbicides was evaluated by comparing the responses of the spring and stream algae and by determining if allowing the streams to be colonized for 3 weeks in the presence of 0.01 mg/kg of the herbicide under test would modify response by selecting for a more resistant flora. Productivity was measured by open-water oxygen methods for 3 weeks before and 3 weeks after herbicide injection. The communities derived from both the spring and the stream were dominated by diatoms, and responded similarly to trifluralin, atrazine, and MSMA, but had divergent re-

sponses to paraquat. Trifluralin had no effect on productivity. Photosynthesis was significantly depressed by 1 and 10 mg/kg atrazine and by 10 mg/kg MSMA, and there were indications of a slight inhibition by 0.01 mg/kg atrazine. Paraquat at 10 mg/kg had little effect on the spring-derived communities but caused severe inhibition of the stream-derived algae. There was little evidence that exposure to 0.01 mg/kg herbicide during colonization modified the response of the algae to any of the herbicides. (Murphy-IVI)
W84-03938

BENTHOS OF A MARINE FLY-ASH DUMPING GROUND,
Newcastle upon Tyne Univ. (England). Dove Marine Lab.
R. N. Bamber.
Journal of the Marine Biological Association of the United Kingdom, Vol. 64, No. 1, p 211-226, February, 1984. 12 Fig, 1 Tab, 30 Ref.

Descriptors: *Water pollution effects, *Fly ash, *Benthic environment, *England, *Northumberland, *Coastal waters, Sediments, Aquatic animals, Powerplants, Industrial waste, Species diversity.

Blyth Power Station, in Northumberland, England is a 1548 MW coal-fired station complex, burning about 16,000 tons of coal per day, resulting in an annual dumping of one million tons of pulverized fuel ash (fly ash) off the adjacent coast. The benthic fauna of the fly-ash dumping ground off the coast was compared with that of the surrounding natural sediments and a designated offshore spoil ground. The silt fraction of the sediments increased as a result of continued ash dumping. The appearance of pozzolanic aggregates at the sites of greatest dumping also occurred, some 3.5 km offshore. The natural benthic macrofauna represented a typical Echinocardium-filiformis community, giving way throughout the offshore spoil ground to a Paraonis-Magelona community dominated by smaller polychaete species more tolerant of poor sediments. An anomalous community structure was evident at the stations at the center of the ash dumping. The density of the fauna was reduced at the center of the ash dumping, the worst station yielding only eight individuals in 0.2 sq m. Contours of numbers of macrofaunal individuals and species, of faunistic diversity and biomass, and of meiofaunal numbers all show a similar pattern of some depression along the spoil ground, and greater depression at the ash-dumping center. A negative correlation between faunistic parameters and ash content was confirmed by statistical analyses. Deposit-feeding species represented a lower proportion of the community at sites of high ash content. The negative correlation between faunistic diversity and ash content was statistically significant over an area of 43 sq km around the center of the dumping. The faunistic impoverishment is considered to be a response to the dumping. (Baker-IVI)
W84-03959

24-H CHANGES IN CHLOROPHYLL CONTENT OF PHYTOPLANKTON OF LAKE JELONEK, AS COMPARED WITH THE PHYSICAL AND CHEMICAL PROPERTIES OF WATER,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
J. Panczakowa, and T. Szyszka.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 3, p 207-227, 1983. 11 Fig, 3 Tab, 16 Ref.

Descriptors: *Chlorophyll, *Phytoplankton, *Lake Jelonek, *Poland, Phosphorus, Nitrogen, Nutrients, Eutrophication, Algal growth, Dissolved oxygen, Carbonates, Hydrogen ion concentration, Aphanizonmenon, Volvox, Melosira.

Measurements were taken in 1979 in the strongly eutrophic polymictic Lake Jelonek of 24-hr changes in the chlorophyll concentration, quality and quantity of phytoplankton and the chemical composition of seston as compared with the physical and chemical properties of water. Three different developmental phases of Aphanizomenon flos-aquae were studied. In June during bloom dying, in addition to Aphanizomenon flos-aquae, Volvox aureus was present, though in small number. In July, during a subsequent increase in the population of Aphanizomenon flos-aquae, relatively large numbers of Melosira granulata occurred. In August the Aphanizomenon flos-aquae predominated. In June, during the dying of the blue-green algae bloom, concentrations of dissolved oxygen and carbonate as well as the pH of water steadily decreased. The chlorophyll content continually fluctuated. In July and August, the chlorophyll content was greatest during the day. In the period of dominance of one species, the numbers of phytoplankton organisms, chlorophyll content, dissolved oxygen concentration and BOD-5 were all evidently related. Phosphorus and nitrogen showed no clear-cut 24-hr changes. (Baker-IVI)
W84-03988

ACTIVITY OF BENZO(A)PYRENE MONOOXYGENASE IN FISH FROM THE SAVA RIVER, YUGOSLAVIA: CORRELATION WITH POLLUTION,
Institut Rudjer Boskovic, Zagreb (Yugoslavia).
N. Kezic, S. Britvic, M. Protic, J. E. Simmons, and M. Rijavec.
The Science of the Total Environment, Vol. 27, No. 1, p 59-69, March, 1983. 1 Fig, 7 Tab, 24 Ref.

Descriptors: *Effects of pollution, *Fish, *Sava River, *Yugoslavia, Benzo(a)pyrene, Enzymes, Benzo(a)pyrene monooxygenase, Organic compounds.

Benzo(a)pyrene monooxygenase (BaPMO) activity in non-migratory fish from a given river segment is highly correlated to the recent pollution history of that part of the river. The enzyme activity level can serve as a relevant measure for the harmful pollutant potential in aquatic ecosystems. Caged experimental fish exposed for about 10 days in river segments show BaPMO activity changes with the same predictive validity as that of the natural population. The dependence of the BaPMO activities from different river segments on the degree of pollution is demonstrated. Measurement of liver BaPMO activities in natural fish populations could be used for detecting the presence, and estimating the quantity of xenobiotics in water. (Baker-IVI)
W84-03991

MUTAGENIC AND CLASTOGENIC EFFECTS OF ORGANIC EXTRACTS FROM THE ATHENIAN DRINKING WATER,
National Hellenic Research Foundation, Athens (Greece). Biological Research Center.
K. Athanasiou, and S. A. Kyrtopoulos.
The Science of the Total Environment, Vol. 27, No. 2/3, p 113-120, 1983. 1 Fig, 3 Tab, 23 Ref
Greek Agency for Scientific Research and Technology grants No. 80045 and 80018.

Descriptors: *Organic compounds, *Drinking water, *Athens, *Greece, *Mutagens, *Clastogens, Chlorination, Agriculture, Public health, Toxicity.

Organic extracts of chorinated drinking water collected from the water distribution system of Athens, Greece, were tested in parallel for their ability to cause mutations in the Salmonella His(+) reversion system and sister chromatid exchanges (SCE) and chromosomal aberrations in CHO cells. The Athens water distribution system supplies a population of more than 3 million people. Water is received into the system from the artificial lake of Marathon. This lake collects the waters of a river (Mornos) located at a distance of 200 km northwest of Athens by means of a canal, and those of the natural lake of Heliki, 100 km north of Athens, in the middle of one of the main cultivated areas of Greece. The extracts induced His(+) revertants in frequencies similar to those detected previously with drinking water extracts from other areas around the world. Organic samples from surface drinking water induced SCE and chromatid type abnormalities in CHO cell cultures, while samples collected from ground drinking water did not. It is possible that the high percentage of mutagens detected in this study results from the chlorination of constituents derived from agricultural runoff. (Baker-IVI)
W84-03993

GROWTH, FECUNDITY AND MORTALITY OF BREAM (ABRAMIS BRAMA) FROM POLLUTED AND LESS POLLUTED SURFACE WATERS IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
W. Slooff, and D. de Zwart.
The Science of the Total Environment, Vol. 27, No. 2/3, p 149-162, April, 1983. 3 Fig, 7 Tab, 34 Ref.

Descriptors: *Water pollution effects, *Fish, *Bream, *Netherlands, Surface water, Lakes, Rivers, Rhine River, Meuse River, Lake Braassem, Lake IJssel.

The performance of bream from surface waters with different degrees of chemical pollution was studied in terms of growth, fecundity, and mortality. Nearly 7000 bream were examined from the river Rhine and its tributaries, the river Meuse and the Lakes Braassem and IJssel. In the polluted areas of the Rhine and its tributaries, fish showed a higher annual mortality than those from less polluted waters. They also, however, showed a higher fecundity, suggesting a compensatory response to an environmental impact. The growth in succeeding spawning years indicates a significant improvement of growth as the population density of Rhine bream has increased during the last few years. The stress of the impact has been reduced recently. The biological observations correspond with differences in chemical pollution of the surface waters which have been surveyed and with a decrease in the concentration of pollutants in Rhine water during the last decade. (Baker-IVI)
W84-03994

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; III. PUBLIC HEALTH ASPECTS, QUALITY STANDARDS AND LEGISLATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
N. D. Bedding, A. E. McIntyre, and J. N. Lester.
The Science of the Total Environment, Vol. 27, No. 2/3, p 163-200, April, 1983. 13 Tab, 56 Ref.
Science and Engineering Research Council Grant GR/B/18263.

Descriptors: *Organic compounds, *Water pollution effects, *Literature review, Public health, Water quality control, Standards, Legislation, Drinking water, Environmental effects.

The health aspects and possible risks from the presence of organic micropollutants in water and waste waters are discussed in this literature review. A comparison is made of the quality standards and legislation which have been promulgated by some countries and international oganizations pertaining to the control of certain organic compounds. Different standards may be applied to waters which are designated for particular uses. Quality standards for the protection of the aquatic environment are generally more stringent than those applied to drinking water. Quality standards developed by different countries and organizations display a broad similarity in most cases, but differ where various approaches have been used in determining the toxicity of and hazards presented by individual compounds. Such legislation will become more comprehensive in the future as more substances are included for recommended treatment procedures. (Baker-IVI)
W84-03995

RECREATIONAL WATER QUALITY AND HUMAN HEALTH,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
A. B. Morrison.
Canadian Journal of Public Health, Vol 75, No. 1, p 13-14, January/February, 1984.

Descriptors: *Reviews, *Water quality, *Recreation, Jurisdiction, Standards, Research priorities, Canada.

A brief review of the First National Conference on Recreational Water Quality and Human Health is discussed. A coordinated effort is necessary for the accomplishment of water quality and human health needs. One mechanism to coordinate federal and provincial activities in the environmental and occupational health field is the Federal-Provincial Advisory Committee on Environmental Health. In developing guidelines for adequate recreational water quality standards it became evident that further research and data-gathering were required. Studies were necessary to determine the association between swimming and microbiological quality of water; investigations on the use of fecal streptococci or enterococci as indicator organisms in bathing beaches; improvement and standardized methods for the isolation and enumeration of viruses in recreational water; improved methods for the isolation and enumeration of pathogens in water; elucidate the extent and degree of recreational water pollution by stormwater and land runoff; obtain communication and cooperation among the agencies responsible for bathing beach water quality. (Murphy-IVI)
W84-04007

VIRUSES AND BATHING BEACH QUALITY,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment.
Canadian Journal of Public Health, Vol. 75, No. 1, p 43-48, January/February, 1984. 6 Fig, 1 Tab, 15 Ref.

Descriptors: *Viruses, *Water quality, *Bathing beach, Recreation, Enteric viruses, Epidemiology, Bacteria, Enterococcus, Poliovirus, Echoviruses, Wastewater disposal, Wastewater pollution, Surface water, Montreal, Canada.

Enteric viruses are always present in domestic sewage as they are constantly being excreted by infected individuals with or without apparent symptoms. Any recreational water contaminated by sewage will thus contain potentially pathogenic viruses. Epidemiological studies have demonstrated that even in the presence of low numbers of bacteria in bathing water there is an increased risk of contracting gastrointestinal illness. Part of this risk is likely to be due to the presence of viruses which have very low minimal infective doses: for poliovirus and echovirus 12, the 50% infective dose is only 20 to 30 viruses. Calculation of the risks involved in bathing in virus contaminated waters show that a standard of less than 25 viruses/L would bring the number of cases to less than 25/1000 bathers. The absence of viruses in one liter of water would insure that there is less than 1 case/1000 bathers. As the endemic level of gastrointestinal symptoms in the population is 25 to 50 cases/1000 persons, this increase would be undetectable. Such a standard would only be adequate if used in conjunction with the present bacteriological standards and perhaps the addition of an enterococcus standard. (Author's abstract)
W84-04011

OTITIS EXTERNA INFECTIONS RELATED TO PSEUDOMONAS AERUGINOSA LEVELS IN FIVE ONTARIO LAKES,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, and R. J. Cook.
Canadian Journal of Public Health, Vol. 75, No. 1, p 83-91, January/February, 1984. 1 Fig, 7 Tab, 35 Ref.

Descriptors: *Otitis Externa, *Pseudomonas Aeruginosa, *Ontario, Lakes, Recreational, Human pathology, Bacteria, Canada.

Studies were undertaken during the summers of 1974 and 1977 to establish the relation of serotypes and phage types of Pseudomonas aeruginosa in recreational water to local cases of external otitis. It was found that there was an increased incidence of infection among swimmers who swam in areas of the lakes where counts were highest. A survey of 424 swimmers and non-swimmers showed that there is a higher occurrence of otitis externa among people under 19 years of age who swim at least five times per week and who have a history of previous ear pathology. (Author's abstract)
W84-04016

GLUCOSE MINERALIZATION ACTIVITY AND THE USE OF THE HETEROTROPHIC ACTIVITY METHOD IN AN ACIDIFIED LAKE,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
L. G. Leduc, and G. D. Ferroni.
Water Resources, Vol. 18, No. 5, p 609-612, 1984. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Glucose, *Mineralization, *Heterotrophic activity method, Acidic water, Bacteria, Glucose mineralization, Hydrogen ion concentration, Ecological effects, Silver Lake, Sudbury, Ontario.

Before a definite conclusion could be made concerning the usefulness of the 'heterotrophic activity method' to measure the rates of decomposition processes in acidic, aquatic environments, it was necessary to study in situ glucose mineralization. Bacterial glucose mineralization samples were taken during the summer from Silver Lake. For Sampling I, linearity between turnover time (t/f) and added substrate concentration (A) did not exist at the in situ pH (3.2) or the experimental pH's (5.5 and 7.0), even though time studies showed that glucose was being mineralized at measurable rates. For Sampling II, modifications were made to the concentrations of labelled glucose and the incubation time. A highly significant linear relationship between t/f and A was demonstrated, and the turnover time and Vmax were calculated to be 472.3 h and 0.005 microg/l/h, respectively. For Sampling III, even though the environmental conditions were similar to those for the previous sampling, a statistically-significant relationship between t/f and A did not result. (Murphy-IVI)
W84-04026

MICROBIOLOGICAL EFFECTS OF WASTEWATER EFFLUENT DISCHARGE INTO COASTAL WATERS OF PUERTO RICO,
Maryland Univ., College Park. Dept. of Microbiology.
D. J. Grimes, F. L. Singleton, J. Stemmler, L. M. Palmer, and P. Brayton.
Water Resources, Vol. 18, No. 5, p 613-619, 1984. 2 Fig, 2 Tab, 24 Ref. NOAA grant NA79AA-D00062, and Office of Naval Research grant N00014-81-K-0638.

Descriptors: *Wastewater discharge, *Ecological effects, *Microbiological studies, *Coastal waters, *Puerto Rico, Fecal coliforms, Coliforms, Bacteria, Chemical wastewater, Domestic wastewater, Streptococcus, Pathogens.

Microbiological effects of non-disinfected, combined chemical and domestic wastewater effluent discharge into coastal waters north of Barceloneta, Puerto Rico were investigated by membrane filter enumeration of fecal indicator bacteria and by enrichment isolation of specific pathogens. A wastewater plume was detected and delineated around the sewage outfall, located 800 m offshore and 30 m below the ocean surface. Fecal coliform and fecal streptococcus counts within the plume were significantly (F test) larger than comparable counts outside the plume. The shape and location of the plume was compatible with current patterns and prevailing winds and extended as far as 3.7 km west of the outfall, at which point the fecal coliform count was 146/100 ml. The average nonplume fecal coliform concentration was < or = 6.7/100 ml. Specific pathogens isolated included Salmonella and Vibrio spp, including V. cholerae non-01 serovar isolated from a nearby river also impacted by the sewage plant. (Author's abstract)
W84-04027

LEAD AND CADMIUM CONCENTRATIONS IN THE HAIR OF FISHERMEN FROM THE SUBAE RIVER BASIN, BRAZIL,
Universidade Federal da Bahia, Salvador (Brazil).
F. Carvalho, T. M. Tavares, S. P. Souza, and P. S. Linhares.
Environmental Research, Vol. 33, No. 2, p 300-306, April, 1984. 1 Fig, 6 Tab, 20 Ref.

Descriptors: *Lead, *Cadmium, *Hair, *Fisherman, Subae River, Industrial wastes, Lead smelter, Metals, Environmental effects, Fate of pollutants, Brazil.

Previous studies have shown heavy pollution by lead and cadmium in the Subae River basin, State of Bahia, Brazil, caused by a lead smelter. Concentrations of these metals were determined in scalp hair of fishermen from three riverside towns and from a reference town. Increased levels for both metals were associated with increasing proximity to the smelter. Mean concentrations of lead and cadmium were higher among fishermen with straight hair than among those with curly hair. The effects of hair washing, hair type, and color and age on metal concentrations in fishermen's hair were studied. (Author's abstract)
W84-04030

CYTOGENETIC EFFECTS OF CADMIUM ACCUMULATION ON WATER HYACINTH (EICHHORNIA CRASSIPES),
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
I. Rosas, M. E. Carbajal, S. Gomez-Arroyo, R. Belmont, and R. Villalobos-Pietrini.
Environmental Research, Vol. 33, No. 2, p 386-395, April, 1984. 1 Fig, 5 Tab, 63 Ref.

Descriptors: *Cytogenetic effects, *Cadmium, *Water hyacinth, Accumulation, Bioindicators, Water pollution effects.

Cadmium was bioassayed to observe cytogenetic effects in the water hyacinth (Eichhornia crassipes). Plants were exposed for 96 hr to freshwater containing 0.01, 0.05, 0.10, 1, 5, and 10 mg/liter of cadmium. Metal concentrations in tissues were determined by atomic absorption spectrophotometry. The highest level was found in roots, thus root-tip cells were used for cytogenetic studies; after 24 hr of exposure, micronuclei, c-mitotic effects, and pycnosis were detected and after 48 hr polyploidy was observed. A linear relationship between frequencies of micronuclei and cadmium concentrations was found; at 1,5, and 10 mg/liter micronuclei numbers were always the lowest. The inhibition of cell proliferation, shown by the low mitotic index, was proportional to the concentration and time of exposure. It may be concluded that water hyacinth is a good sensor, due to its fast rate of metal accumulation, which allows an easy way to determine the presence of potential mutagenic compounds in water. (Murphy-IVI)
W84-04031

DILEMMA OF AN ACIDIC SKY,
Kellogg Corp., Littleton, CO.
T. Jenkins.
American Water Works Association Journal, Vol. 76, No. 3, p 42-49, March, 1984. 3 Fig, 61 Ref.

Descriptors: *Water pollution effects, *Acid rain, Sulfates, Nitrates, Reviews, Water pollution sources, Acidity, Forests, Lakes, Rivers, Legislation, Clean Air Act.

The damaging effects of acid precipitation in North America and Europe are reviewed, followed by a commentary on the controversial political and economic issues associated with forestalling deterioration of the environment. Acid rain refers to the deposition of atmospheric pollutants on soils, vegetation, surface waters, and man-made objects ultimately causing damage because of the pollutants' acidity. Apparent sources of acid atmosphere are primarily human activities. The effects on lakes, rivers, and forests are described. It has been estimated that acid rain causes as much as $5 billion annually in environmental damage, mostly in the northeastern United States and Canada; reducing emissions will cost from $3 to $7

billion annually. Proposed amendments to the Clean Air Act are listed. A comprehensive bibliography is included. (Baker-IVI)
W84-04083

EFFECTS OF ACID PRECIPITATION RUNOFF ON SOURCE WATER QUALITY,
Institute for Research on Land and Water Resources, University Park, PA.
R. T. Leibfried, W. E. Sharpe, and D. R. DeWalle.
American Water Works Association Journal, Vol. 76, No. 3, p 50-53, March, 1984. 2 Fig, 17 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Runoff, *Water quality, Jennerstown, Boalsburg, Pennsylvania, Drinking water, Aluminum, Ryznar Stability Index.

During episodes of acid runoff in February of 1981 and March of 1983, the quality of water in two small streams that provide supplies to the water systems of Jennerstown and Boalsburg, Pennsylvania was monitored. A small impoundment on Card Machine Run provides part of the water for the village of Jennerstown, and Galbraith Gap Run supplies water to a small impoundment that is the main source of water for the town of Boalsburg. Changes in pH, in the concentration of aluminum, and in the Ryznar Stability Index were determined. The magnitude and potential importance of these changes are discussed. Differences in water quality between these two watersheds may have been due to differences in soils, geology, and long-term loadings of acid precipitation on these areas. It is unclear as yet whether the observed changes in source water quality will produce similar changes in the quality of tap water provided to customers in the systems studied. (Baker-IVI)
W84-04084

CURRENT RESEARCH ON THE EFFECTS OF ACID DEPOSITION,
Minnesota Univ., St. Paul. Dept. of Forest Resources.
J. A. Perry.
American Water Works Association Journal, Vol. 76, No. 3, p 54-59, March, 1984. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Water pollution effects, *Acid rain, Emissions, Corrosion, Heavy metals, Metals, Forests, Catchment areas, Water distribution.

Preliminary research aimed at quantifying relationships between emission and acid deposition and on-the-ground effects indicates that small water supplies fed by surface waters or shallow wells and cistern supplies may be adversely affected by acid deposition. Research on acid deposition must address issues such as atmospheric chemistry, distance of transport, and deposition monitoring, in addition to the study of a wide range of other effects. Any decision about methods of controlling acid deposition will ultimately be made on the basis of the effects, and those effects may be real or perceived. Research includes such diverse arenas as a forest canopy's interaction with acidic mists, the geochemistry of stream environments, and the effects on building materials and on the preservation of artifacts, such as the Statue of Liberty, that are located outdoors. Public health aspects, including potential effects on domestic water supplies, are being actively studied. Acid deposition may affect water supplies in three ways: delivery of contaminated water to the catchment, mobilization of contaminants within the catchment, and mobilization of contaminants by corrosion of distribution systems. (Baker-IVI)
W84-04085

ACID PRECIPITATION AND DRINKING WATER SUPPLIES,
Pirnie (Malcolm), Inc., White Plains, NY.
J. S. Reed, and J. C. Henningson.
American Water Works Association Journal, Vol. 6, No. 3, p 60-65, March, 1984. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Acid rain, *Drinking water, *Water pollution effects, Heavy metals, Lead, Lakes, Phytoplankton, Algae growth, Corrosion, Emissions, Fish.

Three areas of concern about the effect of acid precipitation on drinking water supplies were evaluated: the increased levels of heavy metals in raw water, biological imbalances in water supplies, and increased corrosivity of delivered water. Concentrations of heavy metals are below maximum contaminant levels with the exception of lead in a very small number of unbuffered lakes. Trends of levels of metals as a result of continued acid loading are not able to be evaluated with the present data. Phytoplankton populations are frequently less diverse in acidified lakes. Corrosive water is a widespread problem in the United States affecting tap water aesthetics, pipe and plumbing longevity, and, potentially, the health and welfare of the consumer. The distribution of corrosive waters in the state of New York has not been documented. Shallow well water in the Adirondack Mountains is highly corrosive, suggesting the influence of acid precipitation. Strategies to limit acid precursors in the atmosphere are now under intense debate in Congress. Liming, with a treatment life of three years or more, has been demonstrated as an economical and reasonably effective method for restoring fish life in acidified Adirondack lakes. Corrosion control is practiced by only a small percentage of public water systems that have corrosive waters, despite the high cost of corrosion damage and the potential adverse health effects. Effective corrosion control measures include pH adjustment and the addition of corrosion inhibitors at the treatment plant, revisions of plumbing codes, and increased public awareness. (Baker-IVI)
W84-04086

DISTRIBUTION OF HEMICELLULOSE-DECOMPOSING BACTERIA AND ENVIRONMENTAL CONDITIONS IN THE BOTTOM SEDIMENTS IN HIRO BAY,
Shimonoseki Univ. of Fisheries (Japan). Lab. of Microbiology.
M. Murakami, and H. Fujisawa.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 11, p 1707-1715, November, 1983. 1 Fig, 7 Tab, 9 Ref.

Descriptors: *Pulp wastes, *Water pollution effects, *Bacteria, *Hemicellulose decomposing bacteria, *Hiro Bay, *Japan, Heterotrophic bacteria, Aerobic bacteria, Anaerobic bacteria, Agar, Xylan, Glucomannan, Sulfate reducing bacteria.

In the bottom sediments of Hiro Bay (Japan), which is polluted with kraft pulp mill effluent, the distribution of heterotrophic bacteria and hemicellulose-decomposing bacteria, and the environmental conditions were investigated five times from 1979 to 1981. The results on aerobic bacteria were as follows: the number of heterotrophic bacteria, glucomannan-decomposing bacteria, xylan-decomposing bacteria and agar-decomposing bacteria per g of wet sediments were 1000 to 10,000,000, 1000 to 10,000,000, 1000 to 100,000 and 100 to 10,000, respectively. The results on anaerobic bacteria were as follows: the number of heterotrophic bacteria, glucomannan-decomposing bacteria, xylan-decomposing bacteria and sulfate-reducing bacteria per g of wet sediments, were 10,000 to 1,000,000, 100 to 10,000,000, 1000 to 1,000,000 and 1000 to 10,000,000, respectively. The number of aerobic xylan-decomposing bacteria and sulfate-reducing bacteria in Hiro Bay were higher than those in the unpolluted control area (Yoshimi Bay), and the ratio of the number of hemicellulose-decomposing bacteria to that of heterotrophic bacteria in Hiro Bay was also high. (Author's abstract)
W84-04121

ROLE OF EPIDEMIOLOGIC STUDIES IN DERIVING DRINKING WATER STANDARDS FOR METALS,
Massachusetts Univ., Amherst. Dept. of Public Health.
E.J. Calabrese.
Environmental Health Perspectives, Vol. 52, p 99-106, October, 1983. 2 Fig, 1 Tab, 31 Ref. EPA Grant R-805612-02.

Descriptors: *Public health, *Drinking water, *Heavy metals, Arsenic, Sodium, Epidemiology, Reviews, Standards, Metals.

Epidemiological investigations are shown to have contributed in a significant way to our understanding of the potential adverse health effects of drinking water containing elevated levels of several metals. The major restraint in conducting epidemiological research in this area of study has been the mistaken view that drinking water usually contributes only a small percentage of the total daily exposure to any substance. Particular attention in this review is given to arsenic and sodium effects. The sodium tests indicate a sensitivity to blood pressure reduction for women but not for men when small amounts of sodium are removed from the drinking water. Three recent studies in the United States did not find a positive relationship between excess levels of arsenic in drinking water and adverse health effects. (Baker-IVI)
W84-04123

EFFECT OF SODIUM ALKYLBENZENE SULFONATES ON BACTERIOPLANKTON OF THE KIEV RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova, and N. P. Galagan.
Hydrobiological Journal, Vol. 19, No. 1, p 45-48, 1983. 2 Fig, 8 Ref.

Descriptors: *Bacteria, *Plankton, *Reservoirs, Sulfonates, Water pollution effects, Sodium alkylbenzene sulfonates, Kiev, Kiev Reservoir, Bacterioplankton.

The response of bacterioplankton to alkylbenzene sulfonates (ABS) was determined at different initial concentrations of the substrate. While the response depended on the concentration of substrate used, in all experiments the indicators which were monitored showed a considerable deviation from the norm. The indices indicated that the bacterioplankton was more sensitive to a change in the initial concentration of from 2 to 20 mg ABS/liter than to a change from 20 to 100 mg/liter. (Baker-IVI)
W84-04133

BENTHIC FAUNA OF SOME RIVER SYSTEMS IN NAGASAKI DISTRICT; (8) BENTHIC COMMUNITY IN THE RIVER SASU AFTER CONSTRUCTION TO PREVENT MINE-EFFLUENT,
Nagasaki Prefecture Inst. of Health Science and Envirnomental Science (Japan).
S. Ishizaki.
Japanese Journal of Limnology, Vol. 44, No. 4, p 263-268, October, 1983. 2 Fig, 4 Tab.

Descriptors: *Benthic fauna, *River Sasu, *Japan, *Water pollution control, *Mine wastes, Water pollution effects, Heavy metals, Effluents.

The benthic community of the River Sasu was investigated in July 1981 to evaluate the influence of the construction to prevent mine-effluent. The communities in the lower reaches, where the effect of the mine-effluent was recognized in the previous surveys, showed a slight increase in the number of species and change of the dominant species. The heavy metal contents in the water of these areas had decreased in comparison with those of the previous surveys. Change in composition of the benthic community seems to be related to purification of the water quality by construction to prevent mine-effluent. There are some differences in distribution of species such as Gammarus nipponensis, Nemoura asakawae, and Semisulcospira bensoni along the water current, between the River Sasu and Se as a control river. This suggests that there is a decreased but still evident discharge from the abandoned mine in the River Sasu or that there are some discrepancies between the geographical features of both rivers. (Author's abstract)
W84-04164

STUDIES ON A FRESHWATER RED TIDE IN LAKE BIWA - III. PATTERNS OF HORIZON-

TAL DISTRIBUTION OF UROGLENA AMERICANA,
Kyoto Univ. (Japan). Div. of Tropical Agriculture.
Y. Yoshida, K. Kawaguchi, and H. Kadota.
Japanese Journal of Limnology, Vol. 44, No. 4, p 293-297, October, 1983. 7 Fig.

Descriptors: *Red tide, *Lake Biwa, *Uroglena, Plankton, Eutrophication, Chlorophyll a, Water temperature, Water circulation.

In order to clarify the patterns of horizontal distribution of Uroglena americana, investigations were conducted in the water area where the plankton accumulated in the northern basin of Lake Biwa in 1979. Small wings and a tail plane were set on an in situ fluorometer (Variosence II) with a thermistor and the instrument was towed by a ship with the speed of 4 knots at the depth 1 or 1.5 m. The following remarkable variations of patterns were found in the horizontal distribution of chlorophyll a and water temperature: chlorophyll a concentration changes in reverse proportion to water temperature; chlorophyll a concentration changes parallel with water temperature; chlorophyll a concentration changes independently with water temperature. As the cause why these various patterns were found, it was suggested that the types of vertical distributions, of both U. americana and water temperature, the buoyancy of the plankton, the convergence and sinking of surface water, and the convergence and upwelling of surface water, and so on, affected greatly the accumulation of the plankton and the formation of horizontal distribution patterns. (Author's abstract)
W84-04166

NEW GENERAL ESTIMATION OF RIVER POLLUTION USING NEW DIATOM COMMUNITY INDEX (NDCI) AS BIOLOGICAL INDICATORS BASED ON SPECIFIC COMPOSITION OF EPILITHIC DIATOMS COMMUNITIES. APPLIED TO ASANO-GAWA AND SAIGAWA RIVERS IN ISHIKAWA PREFECTURE,
Meiho High School, Kanazawa City (Japan).
M. Sumita, and T. Watanabe.
Japanese Journal of Limnology, Vol. 44, No. 4, p 329-340, October, 1983. 6 Fig, 7 Tab, 15 Ref.

Descriptors: *Rivers, *Diatoms, Japan, Water pollution effects, Sewage, Estimating, Pollution indicators.

The Asano-gawa and Sai-gawa rivers run through Kanazawa City. Since 1960 river pollution has become much worse in the middle and lower courses of these two rivers, the leading cause of which seems to be the very large inflow of domestic sewage caused by the development of the city. River surveys taken at 20 locations allowed the identification of 19 genera and 62 taxa in the River Asano-gawa and 16 genera and 55 taxa in the River Sai-gawa. The number of taxa belonging to two genera, Navicula and Nitzschia, was greater than any number of taxa belonging to the other genera. The development of a numerical index to assess the river pollution by using the diatom community index is discussed. (Baker-IVI)
W84-04170

5D. Waste Treatment Processes

RECENT ADVANCES IN TITANIUM DIOXIDE RECOVERY, FILLER RETENTION AND WHITE WATER TREATMENT,
Lenox Inst. for Research, Inc., MA.
M. Krofta, L. K. Wang, B. C. Wu, and C. C. J. Bien.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-219543. Technical Report No. LIR/06-83/1, June, 1983. 39 p, 1 Tab, 52 Ref, 3 Append. Project No. L8203002, Contract/Grant No. R81PO1-MEAD.

Descriptors: *Pulp, Paper, *Titanium dioxide recovery, *Fillers, *Filler retention, *White water, Treatment, Water reuse, Secondary fiber, Saveall process, Flotation, *Literature review, Wastewater treatment, Byproduct recovery.

Recent developments by research scientists around the world are reviewed and introduced. Topics covered include: the characteristics and application of titanium dioxide and various potential fillers; the definition of filler retention; techniques and chemicals for enhancing filler retention; and various new processes for white water treatment and resources recovery.
W84-03672

ALGAE SEPARATION BY DISSOLVED AIR FLOTATION,
Lenox Inst. for Research, Inc., MA.
M. Krofta, L. K. Wang, R. L. Spencer, and J. Weber.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-219550. Technical Report No. LIR/5-83/6, presented at the Water Quality and the Public Health Conference, Worcester Polytechnic Institute, Worcester, MA, May 24-25, 1983. 19 p, 2 Fig, 6 Tab, 6 Ref. Project No. L8203002.

Descriptors: *Algae, *Flotation, Dissolved air flotation, *Filtration, Water quality, Wastewater treatment, Water treatment, *Separation techniques, *Algae separation.

Algae blooms generally cause a problem for treatment of both potable water supplies and wastewater. Whereas algae may be undesirable in water and wastewater treatment, algae is also being produced in some places for its nutrient value. The objective of this research is to develop a high-rate algae separation system. It has been demonstrated that the dissolved air flotation and filtration system can efficiently separate algae and other pollutants from a surface water body and produce water which meets or exceeds the U.S. Drinking Water Standards. Research data generated from both the laboratory testing, and field testing of a pilot flotation-filtration plant are presented.
W84-03673

PASTEURIZATION OF NATURALLY CONTAMINATED WATER WITH SOLAR ENERGY,
California State Univ., Sacramento. Dept. of Biological Sciences.
D. A. Ciochetti, and R. H. Metcalf.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 223-228, February, 1984. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Decontamination, *Solar energy, Pasteurization, Bacteria, Solar box cooker, River water, Water quality control.

In many parts of the world, people do not have access to a safe water supply, and many diseases are transmitted by consumption of this contaminated water. A solar box cooker (SBC) was constructed with a cooking area deep enough to hold several 3.7-liter jugs of water, and this was used to investigate the potential of using solar energy to pasteurize naturally contaminated water. When river water was heated either in the SBC or on a hot plate, coliform bacteria were inactivated at temperatures of 60 C or greater. Heating water in an SBC to at least 65 C ensures that the water will be above the milk pasteurization temperature of 62.8 C for at least an hour, which appears sufficient to pasteurize contaminated water. On clear or partly cloudy days, with the SBC facing magnetic south in Sacramento, bottom water temperatures of at least 65 C could be obtained in 11.1 liters of water during the 6 weeks on either side of the summer solstice, in 7.4 liters of water from mid-March through mid-September, and in 3.7 liters of water an additional 2 to 3 weeks at the beginning and end of the solar season. Periodic repositioning of the SBC towards the sun, adjusting the back reflective lid, and preheating water in a simple reflective device increased final water temperatures. Simultaneous cooking and heating water to pasteurizing temperatures was possible. Additional uses of the SBC to pasteurize soil and to decontaminate hospital materials before disposal in remote areas are suggested. (Murphy-IVI)
W84-03701

ENTERIC VIRUS AND INDICATOR BACTERIA LEVELS IN A WATER TREATMENT SYSTEM MODIFIED TO REDUCE TRIHALOMETHANE PRODUCTION,
Health Effects Research Lab., Cincinnati, OH.
R. E. Stetler, R. L. Ward, and S. C. Waltrip.
Applied and Environmental Microbiology, Vol. 47, No. 2, p 319-324, February, 1984. 1 Fig, 6 Tab, 22 Ref.

Descriptors: *Enterovirus, *Bacteria, *Water treatment, *Trihalomethane, Water treatment facilities, Chlorination, Alternative planning, Water quality control, Bacterial analysis.

Trihalomethanes formed during the chlorine disinfection step of water treatment are considered to be potential carcinogens. A drinking-water treatment plant with high concentrations of trihalomethanes in its finished water and large numbers of viruses in its source water was located. This plant was used to study the effect of an alteration in the point of chlorination from the first to last step of water treatment on the biological and chemical qualities of its finished water. This alteration caused some reduction in trihalomethane production, but trihalomethane concentrations still exceeded the prescribed limit of 100 microg/liter. No viruses or bacterial indicators were ever isolated from the finished water of the modified plant. Total virus removal by the treatment steps before chlorination (coagulation, sedimentation, and sand filtration) averaged ca. 90%, whereas removal of bacterial indicators by these processes averaged between 88 and 98%. Recoveries of viruses and bacterial indicators in the source water were generally negatively correlated. (Murphy-IVI)
W84-03702

PENETRATION OF DIFFERENT HUMAN PATHOGENIC VIRUSES INTO SAND COLUMNS PERCOLATED WITH DISTILLED WATER, GROUNDWATER, OR WASTEWATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W84-03704

USE OF A MIXED ALGAL CULTURE TO CHARACTERIZE INDUSTRIAL WASTEWATERS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
For primary bibliographic entry see Field 5A.
W84-03705

ENVIRONMENTAL ASPECTS OF THE USE OF NTA AS A DETERGENT BUILDER,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W84-03730

MATERIAL BALANCES OF ORGANICS AND NUTRIENTS IN AN OXIDATION POND,
Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
I. Somiya, and S. Fujii.
Water Research, Vol. 18, No. 3, p 325-333, 1984. 12 Fig, 5 Tab, 21 Ref.

Descriptors: *Oxidation ponds, *Nutrients, *Wastewater treatment, Carbon, Nitrogen, Phosphorus, Tertiary wastewater treatment, Algae, Sedimentation, Regeneration, Assimilation, Sediments, Oxidation.

The apparent removal efficiency of nutrients in a tertiary oxidation pond was 45% in total nitrogen, and 43% in total phosphorus during oxidation pond experiments with 16 days detention time. While the behaviors of these nutrients in an oxidation pond are governed by various transformation processes, the solidification of the soluble inorganic nutrients is predominantly observed. The assimilation rate ranges from 1.06 to 2.61 g C/sq m/day. In the nitrogen balance, denitrification is very im-

portant and produces 66% of the nitrogen removal. In the phosphorus balance, chemical coagulation is a characteristic reaction of phosphorus. The material balance analysis shows clearly that the main reactions in the transformation processes of carbon and nutrients are the assimilation to algae, sedimentation of suspended substance, and decomposition of sediments. The regeneration rates of nutrients from sediments were so active that the removal of nutrients by algal solidification was not effective. (Baker-IVI)
W84-03734

INHIBITORY EFFECT OF OXYGEN ON DENITRATIFICATION AND DENITRITIFICATION IN SLUDGE FROM AN OXIDATION DITCH,
Kyushu Univ., Fukuoka (Japan). Dept. of Chemical Engineering.
M. Nakajima, T. Hayamizu, and H. Nishimura.
Water Research, Vol. 18, No. 3, p 339-343, 1984. 6 Fig, 16 Ref.

Descriptors: *Denitritification, *Oxidation, *Sludge, *Denitratification, Wastewater treatment, Acetylene inhibition method, Oxidation ditch, Aerobic conditions, Anaerobic conditions, Oxygen.

The effect of oxygen concentration on the rates of denitratification and denitritification was investigated using the acetylene inhibition method. The study was conducted during the 1 hr incubation period of return sludge in an oxidation ditch after preculture under anaerobic conditions. As the oxygen concentration increased, the denitratification rate decreased. When the oxygen concentration was above 30 micro M, the reaction was completely suppressed. Denitritification, however, occurred even under aerobic conditions. In the nitrite range of 70-7000 micro M at temperatures of 13 degrees C, the denitritification rate under aerobic conditions was 5-20 micromol/(g-VSS)/hr which was 10-60% that occurring under anaerobic conditions. The inhibition of denitritification by oxygen seemed to conform to a simple competitive inhibition mechanism. (Baker-IVI)
W84-03736

EFFECTS OF PHENOL AND SOME ALKYL PHENOLICS ON BATCH ANAEROBIC METHANOGENESIS,
Alberta Univ., Edmonton. Dept. of Chemistry.
P. M. Fedorak, and S. E. Hrudey.
Water Research, Vol. 18, No. 3, p 361-367, 1984. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Wastewater treatment, *Phenols, *Anaerobic digestion, Cresol, Methane, Biological treatment, Biological wastewater treatment.

Screening experiments with four dimethyphenols, the three cresols and phenol confirmed that only p-cresol and phenol are anaerobically degraded with methane generation. In general, low concentrations of either degradable or non-degradable phenolic substrates were not inhibitory to methanogenesis of other organics in the sludge. Further experiments with varying concentrations of phenol and p-cresol with and without supplemented volatile organic acids showed that the phenol- and p-cresol-degrading acid-forming bacteria are most susceptible to inhibition by the phenolic substrate. By comparison, the non-phenol-degrading acid-formers and methanogens are less susceptible. Accumulation times for phenol and p-cresol methanogenesis were concentration dependent with higher phenolic concentrations requiring longer acclimation times. (Baker-IVI)
W84-03739

USE OF ARTIFICIAL WETLANDS TO REMOVE NITROGEN FROM WASTEWATER,
Ecological Research Associates, Davis, CA.
R. M. Gersberg, B. V. Elkins, and C. R. Goldman.
Journal of the Water Pollution Control Federation, Vol. 56, No. 2, p 152-156, February, 1984. 5 Fig, 1 Tab, 16 Ref. EPA grant CR 807299-01, California Dept. of Water Resources grant B-53459.

Descriptors: *Nitrogen removal, *Wastewater renovation, *Wetlands, Water reuse, Denitrification, Water supply development, Reclaimed water, Wastewater treatment.

Artificial wetlands, when supplemented with methanol to increase the carbon supply and stimulate denitrification, showed very high nitrogen removal efficiencies, 97% of total inorganic nitrogen (TIN) and 94% of total nitrogen (TN) at application rates of 20 to 25 cm/d. Plant biomass, mulched and applied to the surface of the wetlands, was a low-cost alternative to methanol. At a wastewater application rate of 8.4 to 12.5 cm/d, the mean nitrogen removal efficiencies for mulch-amended beds were 95% for TIN and 89% for TN. When the application rate was increased to 17 to 20 cm/d, the mean removal efficiencies decreased to 70% for TIN and 65% for TN. At a wastewater application rate of 8.4 cm/d, endogenous wetland productivity could supply 0.06 kg/cu m carbon, or 67% of the carbon loading value of 0.09 kg/ cu m at which there was an 89% removal of TN. When primary effluent was blended into the secondary wastewater stream at a ratio of 4 cm/d:15 cm/d, the mean nitrogen removal efficiency was 62% for TIN. At the ratio of 6 cm/d:12 cm/d, the mean removal efficiencies were 79% for TIN and 77% for TN. The utility of the artificial wetlands for integrated biological treatment, to perform secondary treatment and nitrogen removal is thus demonstrated. (Baker-IVI)
W84-03794

ANAEROBIC DIGESTION,
Queensland Univ., Brisbane (Australia). Dept. of Chemical Engineering.
W. Forday, and P. F. Greenfield.
Effluent and Water Treatment Journal, Vol. 23, No. 10, October, 1983. 1 Fig, 4 Tab, 58 Ref.

Descriptors: *Anaerobic digestion, *Wastewater treatment, Bacteria, Temperature effects, Metals, Heavy metals, Design criteria.

The principle aims of biological waste treatment are to convert soluble and colloidal wastes into either solid or gaseous materials, thereby making separation easier, and to reduce the volume of solids material which must be handled by partial conversion to the gas phase. In anaerobic digestion, primary, and secondary sludges or high strength wastes are converted to methane, carbon dioxide and a mush smaller amount of solid biomass. The microbiology of anaerobic digestion, environmental effects, and elementary process design concepts are discussed and aerobic and anaerobic systems are compared. Fundamental microbiological and bench scale studies are continually providing a better base on which to design and operate digesters. Novel technological developments have helped to overcome the inherently slow specific rates of organic removal. At the same time, there is growing awareness that certain industrial wastes are not best treated by conventional aerobic processes. Hence, anaerobic digestion now competes with the more expensive specialized aerobic processes. It would appear that there are a number of industrial wastes for which anaerobic treatment is a cost effective, technically sound option. (Baker-IVI)
W84-03881

TRICKLING FILTER ACTIVATED SLUDGE PLANT - PERFORMANCE IN IBADAN,
Ministry of Environment, Ibadan (Nigeria).
C. M. A. Ademoroti.
Effluent and Water Treatment Journal, Vol. 23, No. 10, p 415-419, October, 1983. 2 Fig, 5 Tab, 6 Ref.

Descriptors: *Trickling filters, *Activated sludge process, Wastewater treatment, Wastewater facilities, Suspended solids, Biological oxygen demand, Water quality, Ibadan, Nigeria.

Studies were conducted to determine the qualities of the effluents obtained from a conventional treatment plant in Ibadan. The plant consists of a trickling filter coupled with surface aerated activated sludge unit. It treats wastewater of medium strength coming from a university college hospital community. The average amount of wastewater produced daily by the community is 2.27 x 100 cu m. The plant has been found to reduce the suspended solids, BOD, ammonia-N, phosphate and total coliforms by 85.5%, 92.7%, 64.0%, 6.5% and 92.7%, respectively. However, the nitrate amount was found to increase progressively in the treatment units of the plant. (Author's abstract)
W84-03882

PAPER MILL EFFLUENT TREATMENT,
R. Bragg.
Effluent and Water Treatment Journal, Vol. 23, No. 10, p 435, 1984. 1 Fig.

Descriptors: *Wastewater treatment, *Pulp and paper industry, Pulp wastes, Sludge disposal, Pumps.

Numerous types or grades of effluent are produced from the vast amounts of water used in the paper manufacturing industry. A manufacturer producing a good quality coated paper using clay, filler, and satin white produces an effluent of 350/1100 ppm COD, 500/2400 ppm SS, with a temperature of 22/30 C at a nominal flow rate of 35,000 GPH. Treatment of effluent from such a plant is discussed including the aspects of sludge disposal and pumping requirements. Treatment includes flocculation, clarification, sludge settling, and filtration. The sludge is thickened and dewatered. The treatment allows the recovered water to be reused in the plant or to be acceptable for discharge to the sewer or water course. (Baker-IVI)
W84-03883

BIOLOGICAL NUTRIENT REMOVAL IN THE PHOREDOX PROCESS,
National Inst. for Water Research, Pretoria (South Africa).
A. Gerber.
Effluent and Water Treatment Journal, Vol. 23, No. 11, p 460-467, November, 1983. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Phosphorous removal, *Activated sludge process, Suspended solids, Nutrients, Municipal wastes, South Africa, Design criteria, Phoredox process.

The phoredox process is a treatment sequence specifically designed to remove both nitrogen and phosphate from wastewater. In its most general form this system consists of five stages; the Bardenpho sequence with an additional stage, the anaerobic zone, placed at the head of the process. The phoredox process is generally capable of producing a high quality effluent without the use of chemicals, subject to the presence of sufficient biodegradable organics in the feed, and the provision of adequate anaerobic and primary anoxic retention time. A 100 cu m/d pilot plant was operated continuously for about two years to determine its nutrient removal capability under conditions of rigid plant configuation and operating rules, and to gain an understanding of problems likely to be encountered in practical applications. The wastewater comprised approximately 80% domestic sewage and 20% industrial effluents. Operation of the phoredox pilot plant proved that COD removal and nitrification could be maintained at high levels of efficiency. At an overall average influent COD value of 330 mg/l, phosphate was reduced from 7.2 to an average of 0.8 mg/l in spite of a relatively unfavorable COD/TKN ratio of 9:2 and effluent nitrate concentration of 6.4 mg/l. (Baker-IVI)
W84-03885

REMOVAL OF HYDROCARBONS FROM NILE WATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
A. S. Moursy, and H. I. Abdel-Shafy.
Environment International, Vol. 9, No. 3, p 165-171, 1983. 8 Fig, 7 Tab, 27 Ref.

Descriptors: *Water treatment, *Chlorination, *Coagulation, *Filtration, *Nile River, *Egypt,

*Hydrocarbons, Organic compounds, Rivers, Adsorption, Turbidity, Activated carbon.

The Nile River is the main water supply in Egypt. To determine the efficiency of the existing water treatment facilities in removing hydrocarbons, Nile water was subjected to the same treatment processes used in the local water works. The effectiveness of physicochemical processes involving chlorination, chemical coagulation and sand filtration were investigated. The effect of variable filtration media was also examined. The use of an activated carbon column was considered and the effect of different retention times was evaluated. Chemical coagulation was not an efficient process for hydrocarbon removal. Filtration using either sand or a mixture of anthracite/sand media significantly increased the efficiency of hydrocarbon removal. Increasing the anthracite depth with respect to the total effective depth increased the efficiency of removal of both hydrocarbons and turbidity. Extending the study to include carbon adsorption at different retention times showed that the removal levels of hydrocarbons and turbidity increased by increasing the contact time. The use of activated carbon filter is a promising technique for hydrocarbon removal. (Baker-IVI)
W84-03890

WATERHYACINTHS FOR WATER QUALITY IMPROVEMENT AND BIOMASS PRODUCTION,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and D. L. Sutton.
Journal of Environmental Quality, Vol. 13, No. 1, p 1-8, January-March, 1984. 63 Ref.

Descriptors: *Waterhyacinths, *Water quality, *Biomass, Wastewater treatment, Agricultural wastes, Eutrophic lakes, Aquatic plants, Nitrogen removal, Phosphorus removal, Anaerobic digestion, Water pollution control, Biological treatment, Nutrient removal, Evapotranspiration.

Waterhyacinth, Eichhornia crassipes (Mart.) Solms, is one of the most prominant aquatic weed plant found throughout the tropical and subtropical areas of the world. Researchers have recently recognized that with proper management, waterhyacinth can be effectively used to reduce the pollutant levels of water bodies and potentially use the resulting biomasss for production of gaseous fuels, feed, and fiber. Warm climates in tropical and subtropical areas are conducive for establishing wastewater treatment systems and biomass production farms with waterhyacinth. Sources of nutrients available to culture waterhyacinths include sewage effluent, agricultural drainage water, runoff from animal waste operations, methane digestor effluent, and water from eutrophic lakes and rivers. Growth rates of waterhyacinths were found to be influenced by the nutrient composition of the water, plant density, solar radiation, and temperature. Annual yields of waterhyacinth biomass were found to range from 47 to 106 Mg dry wt/ha/y, with approximately 50% of the biomass produced during May through August. About 35 to 50% of the total biomass was roots when plants were cultured in nutrient-poor waters (eutrophic lake water and drainage effluents), while 14 to 25% of the total biomass was roots for the plants grown in nutrient-rich waters (sewage effluent). Waterhyacinth systems were found to be more efficient in N removal (70-80% reduction) than in P removal (40-50% reduction). A pond with a surface area of 2.65 ha and 1.0 m in depth containing 15 to 30 kg wet wt of waterhyacinth per square meter (750-1500 g dry wt/sq m) and a detention period of 7 d is adequate to treat 3785 cu m/d, million gallons per day (mgd), of sewage effluent. This hypothetical system would achieve 70 to 80% N removal, 40 to 50% P removal, and would produce a biomass yield of 690 to 1060 kg dry wt/d (13-20 g dry wt/sq m/d). The biomass upon anaerobic digestion would yield 180 to 280 cu m of methane/d. This is equivalent to 549 to 843 GJ/ha of energy from waterhyacinth produced at a rate of 48 to 73 Mg dry wt/ha/y. (Murphy-IVI)
W84-03934

FIELD PERFORMANCE OF CONVENTIONAL AND ALTERNATIVE SEPTIC SYSTEMS IN WET SOILS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
C. G. Cogger, and B. L. Carlile.
Journal of Environmental Quality, Vol. 13, No. 1, p 137-142, 1984. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Performance evaluation, *Septic tanks, *Wet soils, Soil saturation, Soil water table, Groundwater pollution, Wastewater treatment, Low-pressure pipes.

Soils with seasonally or permanently high water tables are not considered suitable for septic-tank soil-absorption systems because effluent may not be adequately treated before it enters the groundwater. A number of alternative septic systems have been developed for use in these soils. An 18-month field evaluation of 15 conventional and alternative septic systems was conducted to determine their effectiveness in soils with high water tables. The alternative designs included four low-pressure pipe (LLP) systems, two soil replacement systems, and two pressure-dosed mounds. Water tables were measured and groundwater samples collected monthly from shallow wells placed around each system. The water samples were analyzed for NO3(-)-N, NH4(+)-N, total Kjeldahl N, total P, and fecal coliform bacteria. All but one of the systems installed beneath the natural soil surface were saturated with groundwater for at least part of the year. Effluent treatment was poorest around systems that were continuously saturated with groundwater, with average levels of 7.3 mg/L NH4(+)-N, 1.0 mg/L NO3(-)-N, and 1700 fecal coliform most probable number (MPN)/L found in the groundwater in wells 1.5 m from these sytems. Systems that were only seasonally saturated generally performed better, with average levels of 2.3 mg/L NH4(+)-N, 2.0 mg/L NO3(-)-N, and 560 fecal coliform MPN/L in the groundwater. Mean P levels in the groundwater exceeded 1 mg/L around six of the systems. The highest concentrations were associated with the most heavily loaded systems. Levels of all contaminants decreased with distance from the source. The greatest amount of lateral transport occurred when continuous saturation was accompanied by a steep groundwater gradient. Improved treatment was obtained using the LLP alternative, provided site and soil conditions were acceptable. Soil replacement systems did not improve treatment, while one mound failed due to overloading and abuse. (Murphy-IVI)
W84-03946

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART III (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIGRAPHIQUE, PARTIE III),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 472, p 117-130, 1983. 20 Fig, 3 Tab.

Descriptors: *Combined sewers, *Storm wastewater, *Water pollution control, *Wastewater treatment, Sedimentation, Clarification, Aeration, Filtration, Oil, Biological wastewater treatment.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a discussion of treatment of storm runoff from both combined sewers and separate systems. Treatment methods discussed include the following: decantation; oil and grease removal by sedimentation, clarification, aeration, and filtration; removal of suspended matter by filtration; and biological treatment by higher plants such as Phragmites, Scirpes and Typhas. (Moore-IVI)
W84-03999

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART IV (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIOGRAPHIQUE, PART IV),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 473, p 157-175, 1983. 27 Fig, 1 Tab.

Descriptors: *Water pollution control, *Runoff, *Combined sewers, *Settling basins, Storm runoff, Wastewater treatment, Roads, Highways.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a review of the use of settling basins (or retention basins) in storm runoff treatment and the treatment of runoff from roads and highways. Retention basins are often used for the control of hydraulic problems caused by runoff, but they also serve a complementary purpose in the treatment of runoff water. Types of basins discussed include the following; dry basins, permanent basins, and absorption basins. (Moore-IVI)
W84-04000

MEANS ALLOWING TO REDUCE THE POLLUTION CAUSED BY RUNOFF WATER IN COMBINED AND SEPARATE DRAINS. A BIBLIOGRAPHIC SYNTHESIS, PART V (MOYENS D'ACTION POUR LIMITER LA POLLUTION DUE AUX EAUX DE RUISSELLEMENT EN SYSTEME SEPARATIF ET UNITAIRE. SYNTHESE BIBLIOGRAPHIQUE, PART V),
J. Ranchet, and Y. Ruperd.
Tribune du Cebedeau, Vol. 36, No. 474, p 219-238, 1983. 12 Fig, 3 Tab, 164 Ref.

Descriptors: *Water pollution control, *Runoff, *Combined sewers, Settling basins, Automation, Storm runoff, Wastewater treatment.

Methods actually used or under study for use in controlling pollution from runoff water are discussed in this bibliographic synthesis. This part consists of a review of methods to improve the function of networks, including selection of the type of storm basin, automation of the networks, and treatment of storm overflow alone. The study emphasizes the gaps in present knowledge in the field of pollution control for runoff water. References for all five parts are provided. (Moore-IVI)
W84-04001

AERATOR-BOAT PROJECT APPLICATION TO THE SAMBRE REAERATION (PROJET DE BATEAU AERATEUR APPLICATION A LA REAERATION DE LA SAMBRE),
For primary bibliographic entry see Field 5G.
W84-04002

WATER TREATMENT FOR THE HOME OR COTTAGE,
Environmental Health Directorate, Ottawa (Ontario).
R. S. Tobin.
Canadian Journal of Public Health, Vol. 75, No. 1, p 79-82, January/February, 1984. 2 Tab, 19 Ref.

Descriptors: *Water treatment, Water quality, Water treatment devices, Disinfection, Ceramic candles, Chlorinators, Distillers, Iodinators, Ozonators, Ultraviolet light, Activated Carbon, Greensand filters, Particulate filters, Reverse osmosis, Water softening.

Many types of water treatment devices are available for home or cottage use. Various devices can be selected to disinfect, soften, clarify, and remove undesirable chemicals, tastes and odors. It is important to understand the limits of a particular type of water treatment device and to match its features and capacity to the specific water quality problem to be solved. Performance testing may be required in order to demonstrate the efficacy and life expectancy of the device on various water types. For

disinfection of water to serve the whole house, chlorinators and ultraviolet light devices are the most practical techniques. Ceramic candles, iodinators and ozonators are currently considered the most suitable devices for treating tap water to be used only for drinking and cooking purposes. Distillers can be purchased for either batch or continuous treatment of water and are suitable for use wherever electrical power is present and where sufficient space exists to house the apparatus. For the removal of chemicals and generally improving water quality activated carbon, chlorination, distillers, greensand filters, particulate filters, reverse osmosis and softeners can be used with reasonable efficiency. (Murphy-IVI)
W84-04015

SEPTAGE DISPOSAL IN WASTE RECYCLING PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, S. Udom, and K. H. Choudry.
Water Resources, Vol. 18, No. 5, p 519-528, 1984. 5 Fig, 6 Tab, 33 Ref.

Descriptors: *Septic sludge, *Wastewater disposal, *Recycling ponds, Ponds, Recycling, Algae, Fish, Bacteria, Bacteriophage, Septic tank, Septic wastewater, Wastewater treatment, Water reuse.

With the current energy crisis, the concept of waste recycling rather than simply waste treatment has received wide attention because the recycling or reuse of waste, besides increasing food and energy production, will reduce pollution and disease transfer, if carried out properly. The feasibility of septic tank sludge (septage) disposal into pilot-scale waste recycling ponds for the production of algae and fish is investigated. A septage loading of 100 kg COD/ha/day to four 4-sq m single-stage ponds resulted in the production of algal biomass and dissolved oxygen in the pond water, suitable for Tilapia growth. Some microbiological investigations of this waste recycling scheme were undertaken using ten earth ponds (each with the dimensions of 20 x 10 x 1.3 m: length x width x depth). The densities of coliform bacteria and bacteriophages in the pond water and sediment tended to increase with increased septage loadings and loading periods. The ponds fed with septage at the loading of 100 kg COD/ha/day were found to contain higher densities of these microorganisms than those of the control pond without septage feeding. The possible public health impact resulting from this practice was assessed. (Murphy-IVI)
W84-04018

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES-VII, A COLLOID CHEMISTRY STUDY OF THE EFFECT OF INORGANIC IONS ON THE EFFICIENCY OF CLARIFICATION,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
D. R. Dixon.
Water Resources, Vol. 18, No. 5, p 529-534, 1984. 11 Fig, 1 Tab, 10 Ref.

Descriptors: *Color removal, *Turbidity removal, *Magnetite, *Colloid Chemistry, *Clarification, Chemical properties, Electrochemistry, Ions, Cations, Anion, Electrolytes, Electrophoresis, Hardness, Wastewater treatment, Melbourne, Australia.

The removal of color and turbidity from natural waters by the addition of magnetite is an interfacial process. Furthermore the components of this system are either of colloidal dimensions or of a surface active nature and thus this method of water clarification is very much in the realm of surface and colloid chemistry. Electrokinetic techniques have been used to examine the influence of a number of inorganic species, commonly encountered in the practical situation, on the surface properties of magnetite and consequently on the efficiency of the process. Sodium, potassium, chloride, nitrate and sulfate ions are not strongly adsorbed by magnetite and act only as indifferent electrolytes. The multivalent cations, calcium, aluminum and zinc adsorb strongly, and markedly affect the surface properties of magnetite. For Ca(2+), which does not hydrolyze in the adsorption pH range, specific adsorption occurs, whereas for hydrolyzed cations, electrostatic forces prevail. Phosphate anions are also strongly and specifically adsorbed. From a practical viewpoint, the jar test experiments showed that ionic strength is of importance in regeneration. The presence of small concentrations of heavy metal ions does not affect clarification efficiency and, indeed, magnetite can be used for recovery of heavy metal ions, from effluents. Magnetite can also be used to remove phosphate from effluents. The presence of significant levels of hardness in a feedwater could necessitate changes to the process. (Murphy-IVI)
W84-04019

EFFECTS OF ORGANOTIN ON THE ACTIVATED SLUDGE PROCESS,
AWARE, Inc., Nashville, TN.
Y. Argaman, C. E. Hucks, and S. E. Shelby, Jr.
Water Resources, Vol. 18, No. 5, p 535-542, 1984. 2 Fig, 6 Tab, 9 Ref.

Descriptors: *Organotin, *Activated sludge process, Toxicity, Tributyl tin oxide, Continuous loading, Transient loading, Wastewater treatment, Biological wastewater treatment.

Organotin compounds which find increasing use in marine antifouling paints may be present in the discharge from dry dock operations. This investigation was aimed at determining the effect of such wastewater when discharged to a municipal activated sludge treatment plant. Experiments were conducted using a Warburg respirometer and continuous flow bench-scale activated sludge systems. Unacclimated biological cultures can be inhibited by tributyl tin oxide TBTO concentrations as low as 25 microg/l. However, TBTO doses of over 8000 microg/l can be tolerated by a well acclimated culture. Continuous loading of up to 1000 microg/l TBTO had no effect on organic removal in activated sludge systems. However, an adverse effect on sludge settleability was noticed at 100 microg/l TBTO. Shock loadings of 500 and 1000 microg/l TBTO had no effect on soluble organic removal but resulted in impaired settling and higher effluent suspended solids. The LC50 of TBTO to the fathead minnow was estimated at 45-200 microg/l. The toxicity was reduced considerably by activated sludge treatment. (Murphy-IVI)
W84-04020

PREDICTING ACTIVATED SLUDGE PHOSPHORUS REQUIREMENTS,
Texas Univ. at Arlington.
C. E. Parker, and S. P. Jones.
Journal of Environmental Engineering, Vol. 109, No. 1, February, 1983.

Descriptors: *Phosphorus requirements, *Activated sludge, Prediction, Wastewater treatment, Phosphorus, Organic carbon, Biological oxygen demand, Chemical oxygen demand.

Where receiving waters have strict phosphorus standards, the treatment of phosphorus deficient waste by biological oxidation may not be considered as a viable treatment alternative due to the inability to adequately predict the phosphorus requirements of the biomass. Without a rapid and easy means of establishing phosphorus requirements underestimating, which would adversely affect process operations, or overestimating, which would result in the unnecessary release of phosphorus into the receiving waters, would exist. The objective of this work was to relate established operational parameters of the activated sludge process to the phosphorus requirements of the biomass under aeration. In addition the formulation of a relationship that can be used by the operator in day-to-day operation, was also desired. (Murphy-IVI)
W84-04051

ACCUMULATION OF HEAVY-METAL IONS BY ZOOGLOEA RAMIGERA,
Lund Univ. (Sweden). Dept. of Technical Microbiology.
A. B. Norberg, and H. Persson.
Biotechnology and Bioengineering, Vol. 26, No. 3, p 239-246, March, 1984. 10 Fig, 2 Tab, 17 Ref.

Descriptors: *Heavy metals, *Zoogloea, *Biosorbents, *Biological wastewater treatment, Industrial wastes, Waste recovery, Polysaccharides, Copper, Cadmium, Uranium, Hydrogen ion concentration.

Using microorganisms as biosorbents for heavy metals offers a potential alternative to existing methods for detoxification and for recovery of toxic or valuable metals from industrial discharge water. Zoogloea ramigera, common in sewage plants, produces substantial amounts of extracellular polysaccharide when cultivated on a medium containing carbon source in excess. Biomass has been produced from glucose using Z. ramigera 115, and the biomass has been used to remove copper, cadmium, and uranyl ions from water solutions. The metal uptake was studied with two different methods: either by spectrophotometric measurements on the solutions after flocculation or by potentiometric measurements with amalgam electrodes in order to follow the entire complex formation. The metal-biopolymer interaction in 0.1 M NaClO4 is practically the same as when no neutral salt is added. The uptake and release phases are rapid; within 15 min or less the processes are completed. It is possible to produce biomass at a moderate cost using Z. ramigera. The separation step is rapidly performed by flocculation followed by centrifugation, but sedimentation by gravity alone can be used. The adjustment of pH can be used as a tool for obtaining selective metal uptake. Uranium is effectively adsorbed to the biomass at pH values around 3.5, copper around pH 5.5, and cadmium at pH 6.5. (Moore-IVI)
W84-04120

OPTIMIZATION OF OZONATION AND BIOLOGICAL ACTIVATED CARBON (BAC) IN A WATER RECLAMATION CONTEXT,
National Inst. for Water Research, Pretoria (South Africa).
J. van Leeuwen, J. Prinsloo, and R. A. van Steenderen.
Ozone: Science and Engineering, Vol. 5, No. 3, p 171-181, 1983. 4 Fig, 9 Tab, 11 Ref.

Descriptors: *Reclaimed water, *Ozonation, *Filtration, *Activated carbon, *Biological activated carbon, Effluents, Activated sludge process, Chemical oxygen demand.

When BAC was used in reclaiming water from activated sludge, it was normally exhausted after three months of operation, at a stage when the COD removed fell below 20% of the influent value to the BAC. A pilot plant study was carried out to find the ozone dosage which would cost-effectively extend the operational period of the BAC while maintaining a COD removal of at least 20% for the combined process units of ozonation, filtration and BAC. Cost figures were calculated for a 5,000 cu m/d plant under South African conditions, making provision for the capital amortization, maintenance and operational cost of ozonation, filtration and BAC. An ozone dosage of about 4 mg/l before filtration and BAC led to the most cost-effective COD removal in the reclamation of water from activated sludge effluent. The combination of ozonation, filtration and BAC could maintain a least COD removal fraction of 30% for more than three times as long an inter-reactivation period as for filtration and BAC without ozonation. Filtration has not been found to contribute significantly to the COD removal by the above combination of process units. (Moore-IVI)
W84-04174

5E. Ultimate Disposal Of Wastes

U.S. GEOLOGICAL SURVEY RESEARCH IN RADIOACTIVE WASTE DISPOSAL - FISCAL YEAR 1981,

Geological Survey, Reston, VA. Water Resources Div.
R. Schneider, and N. J. Trask.
USGS Water-Resources Investigations Report 83-4105, 1983. 122 p, 19 Fig, 3 Tab.

Descriptors: *Radioactive waste disposal, *Nuclear wastes, *Radioactive wastes, Wastes.

The report summarizes progress on geologic and hydrologic research related to the disposal of radioactive wastes. The research is described according to whether it is related most directly to (1) high-level and transuranic wastes; (2) low-level wastes, or (3) uranium mill tailings. Included is generic research, applicable to the identification and geohydrologic characterization of waste-disposal sites, to investigations of specific sites where wastes have been stored, and to studies of regions or environments where waste-disposal sites might be located. A significant part of the activity is concerned with techniques and methods for characterizing disposal sites and studies of geologic and hydrologic processes related to the transport and/or retention of waste radionuclides. (USGS)
W84-03553

LAND APPLICATION OF WASTEWATER AND ITS EFFECT ON GROUND-WATER QUALITY IN THE LIVERMORE-AMADOR VALLEY, ALAMEDA COUNTY, CALIFORNIA,
Geological Survey, Menlo Park, CA. Water Resources Div.
M. A. Sylvester.
USGS Water-Resources Investigations Report 82-4100, March, 1983. 53 p, 6 Tab, 17 Fig, 13 Ref.

Descriptors: *Land application, *Wastewater, *Water quality, *Groundwater, Effluents, Livermore-Amador Valley, Alameda County, *California.

Ground-water quality, ground-water level, and rainfall data collected during the 1975 water year through the 1980 water year were analyzed to determine the effects of land application of effluent from wastewater treatment plants on ground-water quality in the Livermore-Amador Valley. Annual rainfall varied markedly during the study: 1976 and 1977 water years had less than one half the normal rainfall; 1978 and 1980 water years had greater than normal rainfall; and 1975 and 1979 water years had nearly normal rainfall. The direction ground-water movement in the valley was found to be generally that of surface water. Dissolved nitrate concentrations were generally much less in areas not receiving wastewater applications than in areas that do. Specific conductance, dissolved solids, dissolved chloride, and dissolved nitrate were substantially less in the lower aquifers than in the upper aquifer in the Livermore wastewater application areas. In the Castlewood, Pleasanton, Veterans Administration Hospital, and Livermore wastewater applications areas ground-water quality was similar to the quality of effluent from wastewater treatment plants in the valley. Rainfall, soil, and geology appeared to be the main determinants of ground-water quality in the Castlewood and Dublin-San Ramon and Camp Parks Military Reservation areas. Wastewater application appeared to be the main determinant of ground-water quality in Pleasanton, Veterans Administration Hospital, and Livermore Municipal Airport areas. Comparison of ground-water quality in wastewater application areas with proposed State water-quality objectives for ground water in the Livermore-Amador Valley showed impaired water quality in all areas. (USGS)
W84-03573

PULP AND PAPER SLUDGE DISPOSAL: THE PROBLEM, CURRENT PRACTICE AND FUTURE DIRECTIONS,
Maine Univ. at Orono. Dept. of Civil Engineering.
C. A. Rock, and J. A. Alexander.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154426, Price codes: A03 in paper copy, A01 in microfiche. Land and Water Resources Center Completion Report, September, 1983. 35 p, 2 Fig, 5 Tab, 72 Ref. Project No. OWRT A-057-ME(4), Contract/Grant No. 14-34-0001-2121.

Descriptors: *Sludge utilization, *Wastewater, *Sludge disposal, Pulp and paper industry, Sludge, Pulp wastes, *Maine, Industrial wastewater.

The 1976 requirement for secondary treatment of pulp and paper mill wastewater has dramatically improved the quality of Maine rivers, but it has also created a new pollution problem, that of sludge disposal. A statewide survey of Maine pulp and paper mills showed that over one million pounds (537 dry tons) of wastewater solids were generated daily. Analyses of the sludges showed a substantial variation from mill to mill, reflecting the mix of raw materials and the different pulping processes used. The data showed that industry-generated sludges had low levels of heavy metals and no pathogens, in contrast to municipal sludges. Nearly all (93 percent) of the sludges generated by Maine mills are disposed of by landfilling. The remaining seven percent are incinerated. Alternative sludge disposal and utilization technologies, including those presented at the symposium 'Long Range Disposal Alternatives for Pulp and Paper Sludges' (Bangor, Maine, October 1982) were reviewed. Each alternative was evaluated in light of Maine conditions. While sludge variability precluded one universal solution, several methods were identified as feasible. Some may provide only seasonal solutions, but each can contribute to solving the industry's sludge management problems.
W84-03670

STUDY OF THE POLLUTION POTENTIAL OF LAND-SPREAD SEPTAGE,
Oregon State Univ. Extension Service, Corvallis.
For primary bibliographic entry see Field 5B.
W84-03722

GROUNDWATER-FLOW PARAMETER ESTIMATION AND QUALITY MODELING OF THE EQUUS BEDS AQUIFER IN KANSAS, U.S.A.,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W84-03784

USE OF STABILIZATION PROCESSES IN THE CONTROL OF TOXIC WASTES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
C. S. Poon, C. J. Peters, and R. Perry.
Effluent and Water Treatment Journal, Vol. 23, No. 11, p 451-459, November, 1983. 2 Fig, 9 Tab, 45 Ref.

Descriptors: *Wastewater treatment, *Waste disposal, Stabilization, Hazardous materials, Clay, Lime, Cement, Chemical reactions, Polymers.

Stabilization is a pre-treatment process that induces chemical change to a waste to form insoluble compounds that entrap toxic elements or compounds in an impervious polymer or stable crystal lattice. Stabilization-solidification processes are classified as fixation processes based upon cement, lime and clay together with encapsulation techniques that use specific organic polymers. Stabilization/solidification methods offer several advantages including improvement in the handling characteristics of the waste while producing a solidified material with sufficient strength to allow for land reclamation. The modified structure significantly reduces the leachability by decreasing the modility and surface are of the waste exposed. Cement based fixation is a process which incorporate the waste as part of a rigid cement matrix. Lime based processes use lime in combination with pozzolanic materials to produce cementitious matrices which chemically and physically entrap the waste. Clay-based fixation uses clay minerals with their cation-exchange capacity and extensive specific surface in combination with a setting agent for the fixation of hazardous wastes. Thermoplastic encapsulation, thermosetting micro-encapsulation, and macro-encapsulation use organic polymers to isolate waste materials. (Baker-IVI)
W84-03884

DETERMINING SLUDGE FERTILIZATION RATES FOR FORESTS FROM NITRATE-N IN LEACHATE AND GROUNDWATER,
North Central Forest Experiment Station, East Lansing, MI.
D. G. Brockway, and D. H. Urie.
Journal of Environmental Quality, Vol. 12, No. 4, p 487-492, 1983. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Sludge disposal, *Fertilization, *Forests, *Leachate, *Groundwater, Groundwater pollution, Coniferous forests, Soil water, Water quality, Municipal wastewater, Pulp wastes.

To meet Federal secondary treatment standards for wastewater descharge, states in the Great Lakes Region must dispose of increasing volumes of sludge in a manner that will not degrade environmental quality nor endanger public health. Applying these residual wastes to land has been identified as a major, cost-effective solution to this problem. Municipal and papermill wastewater sludges were applied to conifer and hardwood forests growing on sandy soils (Entic Haplorthods, Spodic Udipsamments, and Alfic Haplorthods), in northwestern Lower Michigan where annual precipitation averages 765 mm/y, to investigate the impact of sludge on nitrate-N concentrations in soil water and groundwater. During the first growing season after treatment, all forms of N in groundwater and soil water remained near background levels except under aspen (Populus grandidentata Michx.) plots treated with 46 dry Mg municipal sludge/ha. Following the first spring snowmelt period after sludge was applied (spring 1977), nitrate-N concentrations exceeded the 10 mg/L potable water standard in groundwater under plots treated with 16 or more dry Mg/ha undigested papermill sludge. Soil leachate exceeded 10 mg/L under pine plantations receiving 19.3 dry Mg/ha and aspen sprout stands receiving 23 dry Mg/ha or more anaerobically digested municipal sludge. Sludge application rates which would not degrade water quality in water-table aquifers were estimated by regression analysis of nitrate concentrations in relation to dry solids loading. Applying raw papermill sludge at rates not exceeding 9.5 dry Mg/ha (670 kg total N/ha) to a red pine (Pinus resinosa Ait.) plantations was found to be consistent with levels that met the 10 mg/L potability standard in groundwater. These analyses showed anaerobically digested municipal sludge could be applied to a red pine and white pine (Pinus strobus L.) plantation at 16.5 dry Mg/ha (990 kg total N/ha) or less and to aspen sprouts at rates up to 19 dry Mg/ha (1140 kg total N/ha) with the same water quality limits. (Murphy-IVI)
W84-03927

PLANNING MODEL FOR LAND APPLICATION OF SEWAGE SLUDGE,
Cornell Univ., Ithaca, NY.
D. A. Haith.
Journal of Environmental Engineering, Vol. 109, No. 1, p 66-81, February, 1983. 5 Fig, 5 Tab, 19 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Nitrates, *Mathematical models, Percolation, Leaching, Mineralization, Ammonia, Volatilization, Crop uptake.

A simple mathematical model is presented for estimating nitrate-nitrogen concentrations in percolation from sludge land application sites. The model is based on annual mass balances of sludge and soil inorganic nitrogen and includes the processes of mineralization, ammonia volatilization, crop uptake, and leaching. Most input parameters are readily obtained from published sources and standard sludge analyses. Default values are given for the three remaining parameters, which describe ammonia volatilization and nitrogen mineralization. Model predictions compared favorably with field measurements taken over three years in a previous study. The model is generally limited to sites for which the annual water surplus is sufficient to leach all inorganic nitrogen from the root zone. The model also neglects denitrification losses, and may produce conservative over-predictions of nitrate leaching. The model is particularly well-suited to the evaluation of long-term charac-

teristics of sludge and application sites. (Moore-IVI)
W84-04045

5F. Water Treatment and Quality Alteration

ALGAE SEPARATION BY DISSOLVED AIR FLOTATION,
Lenox Inst. for Research, Inc., MA.
For primary bibliographic entry see Field 5D.
W84-03673

DEVELOPMENT OF ALTERNATIVE STERILIZATION METHODS,
Lenox Inst. for Research, Inc., MA.
L. K. Wang, and A. E. Thayer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-225052. Technical Report No. LIR/07-83/1, July 1, 1983. 17 p, 5 Tab, 4 Ref. Project No. L8301001-T, Contract/Grant No. R81P01-B.

Descriptors: *Sterilization, Bacteria, Coliform, *Microwave, Oven, *Pressure cooker, Analytical methods, Mobile laboratory.

Tests run on various water samples containing bacteria indicate that an alternative Microwave-Pressure Cooking method for sterilization of apparatus and materials may be used in mobile laboratories. The proposed sterilization method and the standard sterilization method produced equivalent results. Phosphate buffer and nutrient media plates were run as controls and throughout the experimentation produced no bacterial growth. Microwaving may be used alone to sterilize glassware and some thermal proof plastics. The recommended operational conditions are: highest power setting for 25 minutes. Pressure cooker alone is feasible for sterilization of phosphate buffer, dilution water, and for preparation of bacteria-free water which, in turn, can be used for preparing nutrient media. The recommended operational conditions are: 15 lbs pressure for at least 15 minutes at 100 degrees C. The combination of a microwave oven and a pressure cooker can be an ideal substitute for an expensive autoclave which is being used for sterilization in large medical and water quality control laboratories.
W84-03674

WATER LEVELS OF TRIHALOMETHANES (THM) IN FOUR DIFFERENT SUPPLY SYSTEMS FROM SAO PAULO STATE, (BRAZIL),
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
N. A. G. G. de Fernicola, and F. A. de Azevedo.
Journal of Environmental Health, Vol. 46, No. 4, p 187-188, January/February, 1984. 1 Tab, 14 Ref.

Descriptors: *Water quality, *Trihalomethanes, *Water supply, *Brazil, *Sao Paulo, Water quality control, Drinking water, Water treatment facilities, Chlorination.

During winter-spring of 1980 samples of water from four supply systems were obtained both before and after chlorination at the treatment stations within Greater Sao Paulo, Brazil. They were analyzed for CHCl3, CHCl2Br, CHClBr2 and CHBr3. Trihalomethanes (THM) were not found in raw water of the four main supply systems. Considerable amounts of total THM were found in drinking water from the four systems after chlorination (0.10, 0.07, 0.07, and 0.13 mg/l, respectively). Total THM levels continuously increased from the treatment station to the tap. The supply sytems which showed higher levels of total organic chlorine in the raw waters were also the ones which showed higher levels of THM in the treated tap water. (Baker-IVI)
W84-03723

ARSENIC AND FLUORIDE REMOVAL FROM GROUNDWATER BY REVERSE OSMOSIS,
Kennedy/Jenks Engineers, San Francisco, CA.
R. W. Schneiter, and E. J. Middlebrooks.
Environment International, Vol. 9,, No. 4, p 289-292, 1983. 2 Tab, 7 Ref.

Descriptors: *Groundwater management, *Reverse osmosis, *Fluoride, *Arsenic, Groundwater, Water quality control, Utah, Deseret.

Data are reported from experiments considering removal of naturally occurring fluoride and arsenic from the Deseret, Utah anaerobic groundwater. The groundwater samples were collected from a private well that had been identified as containing arsenic and fluoride concentrations approaching or exceeding the MCL (maximum contaminant levels). Arsenate removals by reverse osmosis approaching 90% were attained for feedwater arsenic concentrations close to 100 micrograms/L. For the same feedwater arsenic concentrations, arsenate removals of only 58% were attained. The maximum contaminant levels for arsenic were satisfied regardless of the arsenic species dominating. Chlorination disinfection oxidized the arsenite to arsenate. Although the feedwater fluoride concentrations were 1.7 and 1.8 mg/L for experimental run 1 and 2, respectively, a 59-67% reduction of fluoride concentration was observed. (Baker-IVI)
W84-03892

CHARACTERISTICS OF A GENERAL MATHEMATICAL MODEL OF WATER-QUALITY MANAGEMENT IN LARGE RESERVOIRS,
For primary bibliographic entry see Field 2H.
W84-03912

MUTAGENIC AND CLASTOGENIC EFFECTS OF ORGANIC EXTRACTS FROM THE ATHENIAN DRINKING WATER,
National Hellenic Research Foundation, Athens (Greece). Biological Research Center.
For primary bibliographic entry see Field 5C.
W84-03993

STUDY ON CHLORINE DISINFECTION OF POND EFFLUENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
C. Polprasert, and V. S. Rajput.
Water Resources, Vol. 18, No. 5, p 513-518, 1984. 6 Fig, 1 Tab, 21 Ref.

Descriptors: *Chlorine, *Disinfection, *Stabilization ponds, Fecal coliforms, Coliforms, Algae, Mathematical model, Contact stabilization, Wastewater treatment.

Chlorine disinfection experiments were conducted to investigate the die-off patterns of the fecal coliforms when present in waste stabilization pond effluents containing from 100 to 400 mg/l algae. The fecal coliform inactivation was observed to occur at two rates, i.e. an initial rapid kill followed by a slower kill. The magnitude of inactivation was found to be proportional to the initial chlorine dose and contact time and inversely proportional to the algal concentration. A mathematical model was developed to predict the fecal coliform survival ratio during the chlorination of the pond effluent. When compared with the experimental data, the predicted results had a correlation coefficient of 0.981. (Author's abstract)
W84-04017

REMOVAL OF ORGANIC PRIORITY POLLUTANTS BY OXIDATION-COAGULATION,
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
S. J. DeLuca, A. C. Chao, and C. Smallwood, Jr.
Journal of Environmental Engineering, Vol. 109, No. 1, p 36-46, February, 1983. 1 Fig, 5 Tab, 30 Ref.

Descriptors: *Water treatment, *Oxidation, *Coagulation, *Potassium ferrate, Flocculation, Priority pollutants, Bromodichloromethane, Trichloroethylene, Dichlorobenzene, Nitrobenzene, Naphthalene, Mathematical models.

The oxidation of a group of priority pollutants with different chemical structures and properties by the use of ferrate is studied. A comparison is made by the coagulation-flocculation of the oxidized pollutants by ferrate with alum coagulation using the jar test. The efficiency of removal of the pollutants by simple air and mechanical (paddle) flocculation is also studied. The pollutants studied are bromodichloromethane (BDCM), trichloroethylene (TCE), 1,2-dichlorobenzene (DCB), nitrobenzene (NB), and naphthalene (NAPH). It is shown that purification of water supply by coagulation with potassium ferrate and stripping with gas removes four out of five wastes listed as priority pollutants. Only nitrobenzene is unaffected. A mathematical model utilizing dipole momentum, solubility parameter and log activity coefficient predicts the efficiency of the process. (Author's abstract)
W84-04043

OPTIMIZING GAC SYSTEMS,
Municipal Environmental Research Lab., Cincinnati, OH. Drinking Water Research Div.
R. M. Clark.
Journal of Environmental Engineering, Vol. 109, No. 1, p 139-156, February, 1983. 6 Fig, 6 Tab, 8 Ref, 1 Append.

Descriptors: *Activated carbon, *Granular activated carbon, *Water treatment, *Cost analysis, Organic compounds, Mathematical equations, Optimization, Adsorbents.

Granular Activated Carbon (GAC) is an effective technique for removing synthetic organics from both ground and surface waters, but questions have been raised over the cost of using GAC in this manner. A series of cost curves for various unit processes including those related to GAC are modified into continuous analytic equations. The equations can be used to estimate total unit costs, and to examine those variables to which the cost of GAC systems are most sensitive. Based on activated carbon use rate, bigger is not better. If the use rate is decreasing with empty bed contact time (EBCT), then larger volumes or greater EBCT's yield lower cost. When activated carbon use rate becomes constant, deeper beds result in higher cost. Cheaper activated carbon could mean higher activated carbon losses and more frequent reactivation. Regional reactivation may result in lower costs, particularly for smaller utilities. Even when optimized, GAC is a relatively expensive technology and should be used only when there are no alternatives. (Moore-IVI)
W84-04047

OPTIMIZATION OF GRAVITY-FED WATER DISTRIBUTION SYSTEMS: THEORY,
Visvesvaraya Regional Coll. of Engineering, Nagpur (India).
P. R. Bhave.
Journal of Environmental Engineering, Vol. 109, No. 1, p 189-205, February, 1983. 4 Fig, 3 Tab, 23 Ref, 1 Append.

Descriptors: *Water conveyance, *Water distribution, *Optimization, *Gravity-fed systems, Linear programming, Feasibility, Network design.

A theory is developed for the optimization of multisource, looped, gravity-fed water distribution systems subjected to a single loading pattern. The method is based on linear programming (LP) techniques and produces a locally optimal solution. Design feasibility constraints are derived to check whether network design and therefore network optimization is feasible. The design feasibility constraints are comprised of the network demand constraint, group demand constraints, and transportation constraints. When the transportation constraints are satisfied, other constraints are automatically satisfied. It is preferable to check the design feasibility constraints in the order in which they are derived as this avoid checking the complicated transportation constraints if the earlier simpler constraints are not satisfied and the design is not feasible. Based on classical transportation problem principles, a theory is developed to formulate an LP problem for obtaining design paths from the source nodes to the demand nodes and thereby for

obtaining the design distribution graph for the entire distribution system. Separate LP optimization models are then formulated to deal with the either the D-specific condition in which the nonprimary links are of some minimum or specified diameter, or the Q-specified condition in which the nonprimary links carry some minimum or specified discharge. (Moore-IVI)
W84-04049

FIELD MONITORING OF CHRYSOTILE ASBESTOS IN CALIFORNIA WATERS,
California Dept. of Health Services, Berkeley. Air and Industrial Hygiene Lab. Section.
For primary bibliographic entry see Field 5B.
W84-04087

SUBSTRATE UTILIZATION BY AN OXALATE-CONSUMING SPIRILLUM SPECIES IN RELATION TO ITS GROWTH IN OZONATED WATER,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
D. van der Kooij, and W. A. M. Hijnen.
Applied and Environmental Microbiology, Vol. 47, No. 3, p 551-559, March, 1984. 7 Fig, 5 Tab, 23 Ref.

Descriptors: *Ozonation, *Carboxylic acids, *Spirillum, Biodegradation, Water treatment, Oxalic acid.

Ozonation of water containing organic compounds which are resistant to biodegradation results in the formation of a number of easily biodegradable carboxylic acids. An attempt was made to develop a microbiological method to quantify the presence of the easily biodegradable carboxylic acids, including oxalic acid. The nutritional versatility of a vibrio-shaped, oxalate-utilizing isolate, strain NOX, obtained from tap water supplied with low concentrations of formate, glyoxylate, and oxalate, was determined by growth experiments with low-molecular-weight carbon compounds at high (grams per liter) and very low (micrograms per liter) concentrations. Strain NOX was isolated from the filtrate of slow sand filters of the Municipal Dune Waterworks, The Hague (Netherlands). The organism, identified as a Spirillum species, appeared to be specialized in the utilization of a number of carboxylic acids. Yields of 2,900,000 CFU/micro g of oxalate C and 12,000,000 CFU/micro g of acetate C were obtained from growth experiments in tap water supplied with either oxalate or acetate. A substrate saturation constant of 0.64 micro M oxalate was calculated for strain NOX. Maximum colony counts of strain NOX grown in ozonated water (dosages of 2.0 to 3.2 mg of O3 per liter) were 15 to 20 times larger than in maximum colony counts of strain NOX grown in water before ozonation. Oxalate concentrations were calculated from the maximum colony counts of strain NOX grown in samples of ozonated water in which a non-oxalate-utilizing strain of Pseudomonas fluorescens had already reached maximum growth. The oxalate concentrations obtained by this procedure ranged from 130 to 220 micro g of C/liter. (Moore-IVI)
W84-04119

INVESTIGATIONS ON THE CHANGES OF BIOLOGICAL DEGRADABILITY OF SINGLE SUBSTANCES INDUCED BY OZONATION,
Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie.
E. Gilbert.
Ozone: Science and Engineering, Vol. 5, No. 3, p 137-149, 1983. 16 Fig, 9 Ref.

Descriptors: *Water treatment, *Ozonation, *Biodegradation, Drinking water, Carbon filters, Oxidation, Aniline, Benzene sulfonic acid, Cresols, Humic acid, Biological treatment, Aromatic compounds.

Toxic or difficulty degraded substances can be converted, by means of ozonolysis, to biologically active groups of substances, but an excess of ozone of 3-6 g O3/g DOC is necessary. Water works generally employ doses of 1-2 g O3/g DOC, which may be the reason for the observed destruction of biological activities in carbon filters, since at low doses the dissolved substances may be only partially oxidized or poorly degradable intermediate products may be formed. The ozonolysis of some model compounds was performed. The reactions of aniline, benzene-sulfonic acid, 4-chloro-o-cresol, 2-nitro-p-cresol and humic acid with ozone show that after low ozone doses (1 g O3/g DOC) the products formed are not biodegradable as in the case of aniline (BOD5/COD = 0.05) or that the intermediate products are not much easier to degrade than the initial substances. BOD5/COD values of 0.05 - 0.25 were found. With low doses of ozone used in drinking water works the substituted aromatics are only partly degraded. Non-biodegradable intermediates are formed, which are converted to stable biodegradable oxidation products by higher ozone doses. (Moore-IVI)
W84-04172

OZONATION OF SOME AROMATIC COMPOUNDS IN AQUEOUS SOLUTION: STYRENE, BENZALDEHYDE, NAPHTHALENE, DIETHYLPHTHALATE, ETHYL AND CHLORO BENZENES,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, S. Guyon, H. Sugimitsu, and M. Dore.
Ozone: Science and Engineering, Vol. 5, No. 3, p 151-170, 1983. 20 Fig, 1 Tab, 20 Ref.

Descriptors: *Aromatic compounds, *Ozonation, *Drinking water treatment, *Styrene, *Benzaldehyde, *Naphthalene, *Diethylphthalate, *Ethylbenzenes, *Chlorobenzenes, Surface waters, Oxidation, Gas stripping.

Many simple aromatic compounds found in surface waters can be removed by ozone in the process of drinking water treatment. Ozonation of some of the aromatic compounds frequently found in French surface waters was studied in an aqueous medium. As far as the reactivity is concerned, the values of the ozone consumed per initial aromatic consumed (molar ratio ozone demand), were determined in a semi batch bubble column at slightly acidic pH. As for the ozonation products, the application of specific experimental procedures in high concentration aqueous solution after the use of derivatization reactions, allowed the isolation (PLC, GC) and identification (GC/MS ; MS, NMR) of some degradation products in the cases of benzaldehyde and naphthalene. The development, in dilute aqueous solution, of some ozonation products (HPLC, GC), is followed for styrene, benzaldehyde, naphthalene and diethylphthalate. The mechanisms of initial steps of ozonation are examined in the case of styrene, of benzaldehyde and of naphthalene. It was not possible to isolate the ozonation products of chlorobenzenes and ethylbenzenes. The ozonated gas stripping of these compounds was more significant. (Moore-IVI)
W84-04173

5G. Water Quality Control

ARE CHANGES IN PHYTOPLANKTON ASSEMBLAGES OF PIBURGER SEE CONSEQUENCES OF HYPOLIMNETIC WATER REMOVAL (SIND DIE VERANDERUNGEN IM PHYTOPLANKTONBILD DES PIBURGER SEES AUSWIRKUNGEN DER TIEFENWASSERABLEITUNG),
Innsbruck Univ. (Austria). Botanisches Inst.
E. Rott.
Archiv fur Hydrobiologie, Suppl 67, No. 1, p 29-80, October, 1983. 10 Fig, 4 Tab, 77 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Lake restoration, Trophic state, Eutrophication, Hypolimnion, Seasonal variation, Lake Piburger, Mesotrophic lakes, Hypolimnetic outlets.

Studies of seasonal and long-term periodicity of phytoplankton are used to characterize the development of Lake Piburger, a small meromictic and mesotrophic lake situated in a forested area. In order to avert fish-kill by complete oxygen depletion, a hypolimnetic outlet was introduced to enhance the export of oxygen-poor and nutrient rich water. Effects of the restoration measures on the phytoplankton periodicity are traced. Data on the relative abundance of the main taxonomic groups for each sampling depth and the respective weighted means in absolute figures give some general information on the successional pathway and the ecological demands of the main phytoplankton groups. Characteristic distribution patterns, which largely regulate the distribution of total biovolumes of phytoplankton are shown for bluegreen algae, green algae and Chrysophyceae. The seasonal periodicity of phytoplankton in Piburger See is following constant patterns due to a strong stratification tendency. The sequence of the annual means of phytoplankton demonstrates the increase of blue-green algae from 1972-75 and simultaneous increase of total biovolumes from 1972-76. It is difficult to relate this development to some form of internal eutrophication due to hypolimnetic water removal, since a second increase of blue-green algae and total biovolume has been observed in 1981 after 10 years functioning of the Olszewski-tube and since primary productivity generally remained more or less constant. For the special mesotrophic situation of Piburger See the restoration measure used did not cause fundamental changes of seasonal and long-term periodicity of phytoplankton. (Baker-IVI)
W84-03507

PREVENTION OF ACID DRAINAGE FROM STORED COAL,
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
H. Olem, T. L. Bell, and J. J. Longaker.
Journal of Energy Engineering (ASCE), Vol. 109, No. 2, p 103-112, June, 1983. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Acidic water, *Drainage, *Coal, Storage, Wastewater treatment, Sodium lauryl sulfate, Leachates, Leaching, Cost analysis.

The most efficient method now used for storing large quantities of coal is placement on the ground. Because the coal is exposed to the elements, rainwater falling on the pile can become contaminated by the action of chemolithotrophic bacteria on pyritic materials (usually iron disulfides). A method has been identified for controlling acid production and subsequent dissolution of toxic pollutants in drainage from coal storage piles. Results of laboratory and field experiments indicate that it may be possible to prevent, rather than treat, acid drainage by periodically applying an environmentally safe detergent formulation to the coal. These experiments showed that a mild solution of sodium lauryl sulfate (SLS) effectively blocks the activity of the bacteria that promote acid formation and chemical leaching. Drainage from coal treated once with 50 mg/L of SLSf remained neutral for 60 days, about three times longer than the untreated control sample. An extrapolation of results to an industrial-scale application revealed that the cost of the SLS needed for a single application would likely be no more than $200 per acre of coal storage area ($500 per hectare) or, expressed per unit weight of coal, $4,000 per million metric tons. (Murphy-IVI)
W84-03714

RESERVOIR MANAGEMENT,
Waco Water Treatment and Pollution Control, TX.
M. D. Meadows.
Southwest and Texas Waterworks Journal, Vol. 65, No. 11, p 8-12, February, 1984. 3 Tab.

Descriptors: *Reservoir operation, *Water quality control, *Waco, *Texas, Watershed management, Taste, Odor, Algal control, Algicides, Copper sulfate, Destratification.

The first step in insuring the water consumer of the highest quality product possible is to implement a stringent reservoir management program. The characteristics of the reservoir will determine how to develop, evaluate, and use a particular management program at the location of the reservoir. Methods used in the city of Waco, Texas for

reservoir management since 1965 are reviewed. The program includes watershed monitoring, routine reservoir sampling, algae control methods and artificial destratification. The sampling involves testing for microbiological status as well as physical and chemical analyses. Sampling point locations were selected such that the data gained would produce information that tells what the condition of the water draining into the reservoir is, and the quality of the water exiting to the treatment facility. A destratification system is operated from March to October to control taste and odor problems. The watershed monitoring program includes the use of the routine sampling program as the first indicator of changes within the watershed. Visual observations included in the program consist of aerial surveys, land surveillance using automobiles, and water surveillance using boats. Copper sulfate is considered to be the most most generally accepted and effective algicide. (Baker-IVI)
W84-03801

LIMING OF ACIDIFIED SWEDISH LAKES AND STREAMS AND ITS CONSEQUENCES FOR AQUATIC ECOSYSTEMS,
Goeteborg Univ. (Sweden).
B. Hasselrot, and H. Hultberg.
Fisheries, Vol. 9, No. 1, p 4-9, January-February, 1984. 6 Fig, 29 Ref.

Descriptors: *Lime, *Acidic lakes, *Acidic streams, *Sweden, *Ecological effects, Neutralization, Water quality, Benthic fauna, Toxicity, Aluminum, Retention time, Lime application, Chemical properties.

Acidification of poorly buffered lakes, with negative effects on fish populations as well as the functioning of whole aquatic ecosystems, prompted an extensive program for neutralization of surface waters in Sweden. The biological response to lake liming has been mainly positive, especially in lakes with water retention times of more than 1-2 years, and in lakes where the deleterious effects of acidification have been moderate. Liming promotes decompositional processes. Whether it results in a temporary or permanent increase in nutrient recycling, is not yet known. The number of phytoplankton species generally increases in limed lakes. Zooplankton species which are sensitive to acidification reappear often spontaneously in limed lakes within a few years. The benthic fauna, established during the acid period, changes over several years following liming. New species invade during the neutral conditions and populations of acid sensitive species, previously present at very low levels, expand. The biomass of chironomids often decreases after neutralization. Reproduction and recruitment of fish have generally been successful in lakes where satisfactory water quality has been achieved. Toxicity to fish due to aluminum after liming has been reported. Liming techniques for lakes with short water retention times and especially for running waters, have not been fully developed in the Swedish liming program. The neutralized aquatic ecosystem is not a restored 'unpolluted' ecosystem. It is a new stage in the lake history, where organisms survive but are stressed by the continued input of acid drainage waters with elevated concentrations of metals. (Author's abstract)
W84-03808

WHOLE-LAKE NEUTRALIZATION EXPERIMENTS IN ONTARIO: A REVIEW,
W. A. Scheider, and T.G. Brydges.
Fisheries, Vol. 9, No. 1, p 17-18, January-February, 1984. 13 Ref.

Descriptors: *Water quality control, *Lake restoration, *Neutralization, Acidity, Heavy metals, Copper, Middle Lake, Lohi Lake, Hannah Lake, Nelson Lake, Sudbury, Ontario, Phosphorus, Fish behavior, Fisheries, Water pollution effects.

There are numerous lakes with low pH and elevated metal content in the Sudbury (Ontario) area because of the activities of the local mining and smelting industries. Techniques for improving water quality and subsequently the fisheries of four acidic, metal-contaminated lakes in the Sudbury area (Hannah, Middle, Lohi, and Nelson Lakes) were sought. All lakes were neutralized with Ca(OH)2 and CaCO3. Two lakes, Hannah and Middle, were fertilized 1-2 years after neutralization with low level additions of phosphorus. An immediate decline in phytoplankton standing stock followed neutralization, but levels returned to pretreatment values within a few months. The lakes were then stocked with fish, but extensive netting yielded no fish from either Lohi Lake nor Middle Lake. Mortality of the stocked species was attributed to waterborne Cu toxicity. (Baker-IVI)
W84-03809

IN SITU MANIPULATION OF WATER CHEMISTRY USING CRUSHED LIMESTONE AND OBSERVED EFFECTS ON FISH,
Ontario Ministry of Natural Resources, Toronto.
J. M. Gunn, and W. Keller.
Fisheries, Vol. 9, No. 1, p 19-24, January-February, 1984. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Fish, *Water quality control, *Limestone, *Acidity, Acid lakes, Ontario, Sudbury, Neutralization, Trout, Growth stages, Hydrogen ion concentration.

Limestone additions were made to acidic lakes near Sudbury, Ontario to create favorable microenvironments for early life stages of salmonids (trout). Substrate baskets containing as little as 15 kg crushed limestone neutralized interstitial water under acutely toxic conditions where pH levels were 4.6 and total aluminum was greater than 400 micrograms/liter. Neutralization of the water permitted high survival rates of incubating eggs and fry. Flow-through filter tanks and stream bed additions were used to neutralize flowing water with similar results. Both procedures produced significant changes in water chemistry including elevations in pH, alkalinity, conductivity and calcium content. A 345 tonne stream bed addition was largely ineffective at controlling springtime pH depressions but produced substantial annual increases in the downstream discharge of alkalinity. Small-scale treatments such as limestone covered spawning sites may be of remedial value in acidic systems. (Baker-IVI)
W84-03810

EXPERIMENT ON THE FEASIBILITY OF REHABILITATING ACIDIFIED ATLANTIC SALMON HABITAT IN NOVA SCOTIA BY THE ADDITION OF LIME,
Toronto Univ. (Ontario).
W. J. White, W. D. Watt, and C. D. Scott.
Fisheries, Vol. 9, No. 1, p 25-30, January-February, 1984. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Rehabilitation, *Habitats, *Salmon, *Nova Scotia, *Lime, Acid lakes, Hydrogen ion concentration, Chemical properties, Chemical treatment, Environmental effects, Mixing, Sandy Lake.

In 1981, the Department of Fisheries and Oceans carried out an experimental neutralization of an acidified lake in Nova Scotia. The purpose of this experiment was to determine whether lake liming could be used as a technique to control the pH of Atlantic salmon habitat downstream from the lake and to learn the proportion of lime which would be dissolved, the effects of liming on water chemistry, and the duration of these effects relative to the retention time of water in the lake. The experiment was carried out on Sandy Lake in the Sackville River system near the town of Bedford, Nova Scotia. Sandy Lake is 74 ha in area, 5,100,000 cu m in volume, and its retention time is 0.34 years. Its water chemistry was normal for lakes in the Halifax area and its pH was between 4.5 and 5.0 before lime was added. In July and August 1981, 135,000 kg of CaCO3 were mixed with water in a mixing tank mounted on a boat and then spread over the lake surface. The pH of the epilimnion rose quickly from below 5.0 almost to 7.0 and that of the hypolimnion rose approximately to 6.0. Following fall overturn, the whole-lake pH fell quickly almost to its pre-liming value. Fluctuations of pH 3 km downstream from the lake were equal to those in the lake. The effects of liming on pH had disappeared by the end of February 1982. On a few occasions in the fall and winter following liming, a shallow stratum of exceptionally acid water overlay the mass of limed water in the lake. The usefulness of lakes as reservoirs of neutralized water may be reduced by incomplete mixing of acidic inflows with the lake water and consequent low pH of the outflow. By the end of 1982, approximately 60% of the lime added to the lake had been detected in the water column. The remainder is presumed to have been immobolized on the lake bottom. Concentrations of Al, Mn, Cu, and Zn were significantly lower following liming but that of Fe was higher. Although it is feasible to add lime to headwater lakes to regulate fluctuations in the pH of rivers and to maintain the pH at levels favorable to Atlantic salmon; in Nova Scotia where lakes are small and their rates of flushing are rapid, lime must be added at frequent intervals. (Author's abstract)
W84-03811

TREATMENT OF NEW YORK'S ADIRONDACK LAKES BY LIMING,
W. A. Kretser, and J. R. Colquhoun.
Fisheries, Vol. 9, No. 1, p 36-41, January-February, 1984. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Lake restoration, *Water quality control, *New York, *Adirondacks, Neutralization, Limestone, Acid lakes, Lime, Policy.

Neutralizing agents have been used in New York to raise the pH of lakes since 1959. Several ponds were treated with hydrated lime to improve the survival of stocked salmonids in the first phase of the program, from 1959 to 1963. The second phase consisted of treatments with various limestone and lime products during the 1970's. The third phase, conducted concurrently with the second phase, involved tests with a variety of neurtalizing agents and application rates. The effects of lake neutralization on aquatic ecosystems are still poorly known. Until more is known about the effects of treatment, the policy of the New York State Department of Environmental Conservation is to conduct only a limited number of treatment projects as needed to protect unique or extremely valuable aquatic resources, prior to implementation of an emissions control program and reduction in acidic deposition. (Baker-IVI)
W84-03813

NEUTRALIZATION OF ACIDIFIED STREAMS IN WEST VIRGINIA,
West Virginia Dept. of Natural Resources, Elkins. Operations Center.
P. E. Zurbuch.
Fisheries, Vol. 9, No. 1, p 42-47, January-February, 1984. 4 Fig, 1 Tab, 7 Ref.

Descriptors: *Water quality control, *Streams, *Acidity, *Neutralization, *West Virginia, Limestone, Acid precipitation, Lime, West Virginia.

Many streams in the north central and western parts of West Virginia have been severely impacted by acid mine drainage (AMD). A number of others, especially in the eastern mountains, are lightly buffered and small amounts of acid, from mining or acid precipitation, cause severe problems for fisheries. Early efforts made in the neutralization of acidic streams in West Virginia concentrated on lightly buffered waters that gained most of their acid content from watershed geologic conditions. Research led to a method of treating acid stream flow with limestone aggregate contained in water powered rotating drums. Recent development has occurred on a second generation drum that is self-feeding from streamside stored aggregate. The new system's efficiency may permit its application in large streams affected by acid precipitation. (Baker-IVI)
W84-03814

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 1. MODEL DESCRIPTION,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2A.
W84-03820

ACID MINE DRAINAGE FROM RECLAIMED COAL STRIP MINES 2. SIMULATION RESULTS OF MODEL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2A.
W84-03821

STATISTICAL METHOD FOR THE ESTIMATION OF TREND IN SALINITY IN THE RIVER MURRAY,
Australian National Univ., Canberra. Dept. of Statistics.
R. B. Cumningham, and R. Morton.
Australian Journal of Soil Research, Vol. 21, No. 2, p 123-132, 1983. 5 Fig, 2 Tab, 4 Ref.

Descriptors: *Salinity, *River Murray, *Australia, Chlorides, Water quality control, Statistical analysis, Estimating, Low flow.

A simple statistical model is presented for the analysis of salinity measurements. The model is illustrated in detail for chloride concentration determinations in the River Murray at Morgan, South Australia, over a period of 43 years. High salinity in the lower Murray waters poses many present and potential problems for agriculture, domestic and industrial users of the water. Small changes in water quality are often difficult to detect because of large variability in the data, particularly in the lower reaches of the River Murray, where the problem is most acute. Estimates of trend cannot be properly be interpreted unless there is an appropriate statistical model to account for this variability. A positive trend has occurred in the river over and above that associated with a decline in waterflow. Some insight into the form of the trend is provided by a moving average of the log-chloride concentration after allowing for waterflow effects. Despite such extensive data, the linear component of this trend is not precisely established, as is clear from the wide confidence limits. (Baker-IVI)
W84-03876

USING VEGETATION FOR NON-STRUCTURAL SEDIMENT CONTROL,
Land-Tech Consultants, Inc., Ridgefield, CO.
For primary bibliographic entry see Field 6F.
W84-03987

AERATOR-BOAT PROJECT APPLICATION TO THE SAMBRE REAERATION (PROJET DE BATEAU AERATEUR APPLICATION A LA REAERATION DE LA SAMBRE),
J. Dequinze.
Tribune du Cebedeau, Vol. 36, No. 477-478, p 375-380, 1983. 4 Fig.

Descriptors: *Aerator boat, *Wastewater facilities, Sambre River, Water pollution treatment, Water treatment facilities, Aerators, Dissolved oxygen, Prototypes.

A good means of increasing the dissolved oxygen concentration in natural and artificial bodies of water is to use an aerator-boat. The Sambre river is used to demonstrate the flexibility and efficiency of the aerator-boat because the river is heavily polluted. The aeration-boat is equipped with an American aeration apparatus composed of 48 jets immersed approximately 2 to 3 meters. The ejection nozzles have been fitted for use as propulsion devices and for aeration reaction purposes. The actual size of the boat is 26 m in length, 3.6 meters in width and weighs 25 tons. The aeration apparatus is 16.8 m long with the jets set 0.7 meters apart. Protection of the ramp is assured by a lower horizontal deflector which helps to avoid contact with high bottom sediment which might then be resuspended. The aerator-boat is adaptable for use in natural waters (rivers, lakes) and for artificial basins (chemical wastewater lagoons). (Murphy-IVI)
W84-04002

PLANNING MODEL FOR LAND APPLICATION OF SEWAGE SLUDGE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5E.
W84-04045

PHOSPHORUS MANAGEMENT TO PROTECT LAKE WATER QUALITY,
Pennsylvania State Univ., University Park. School of Forest Resources.
L. M. Antosch.
Water Resources Bulletin, Vol. 20, No. 1, p 23-26, February, 1984. 1 Fig, 4 Tab, 12 Ref.

Descriptors: *Water quality management, *Phosphorus, *Gravel pit lakes, *Lakes, *Iowa, *Ames, Water supply, Land use, Drainage, Chlorophyll a, Pollution load.

During the midwestern drought of 1976 and 1977, the City of Ames, Iowa, experienced a water shortage and had to rely of the Hallet Quarry gravel pit lakes as a supplemental source of drinking water. The importance of this water resource was realized from this experience and plans were initiated to try to incorporate it into the municipal water source. A concern about future water quality arose when sand and gravel extraction operations altered the surface drainage pattern. A modified version of the Vollenweider input-output model was used to predict further water quality under various watershed land use, drainage, and lake configurations. The future lake total phosphorus and chlorophyll a concentrations are dependent upon two factors: the lake configuration, and the phosphorus load. A single lake would have about a 20% lower chlorophyll a concentration than the south lake in the two lake group, due to the increased lake volume and surface area and reduced flushing rate. Reducing the phosphorus load would produce a greater reduction in chlorophyll a concentrations than having a larger lake. It is recommended that a management plan to protect the future water quality should be oriented towards reducing the sources of phosphorus to the lakes. (Moore-IVI)
W84-04100

WATERBORNE NUTRIENT BUDGETS FOR THE RIPARIAN ZONE OF AN AGRICULTURAL WATERSHED,
Georgia Univ., Athens. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W84-04114

WATER-TABLE RISE DUE TO INFILTRATION FROM CANALS,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Water Resources and Environmental Engineering.
M. A. Gill.
Journal of Hydrology, Vol. 70, No. 1-4, p 337-352, 1984. 12 Fig, 2 Tab, 6 Ref.

Descriptors: *Infiltration, *Irrigation, *Groundwater contamination, Salinity, Canals, Water table fluctuations, Water pollution sources.

One dimensional analysis of the rise of water table under the influence of infiltration from a canal of constant water level is treated. Results are also presented for more than one canal recharging an aquifer. The case of unsymmetrical (eccentric) location of a canal which is parallel to the boundaries of the aquifer is also treated. It is assumed that the linear equation of mass conservation can adequately predict the phenomenon of rising water table due to infiltration from canals. Predictions from the formulated solutions can be accepted as first approximate estimates which can later be refined using numerical methods for solving the non-linear equations, if needed. Numerical results are presented graphically. (Baker-IVI)
W84-04160

VARIATION OF LAS AMOUNT IN RIVERS AFTER PROHIBITION OF DETERGENTS CONTAINING PHOSPHORUS,
Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).
Y. Tanaka, H. Nakanishi, T. Tsuda, and K. Matsushita.
Japanese Journal of Limnology, Vol., 44, No. 4, p 298-303, October, 1983. 7 Fig, 3 Tab.

Descriptors: *Detergents, *Linear alkylbenzenesulfonate, *Lake Biwa, *Shiga Prefecture, *Japan, Water pollution control, Phosphorus, Sediments, Organic matter.

The Lake Biwa Eutrophication Prevention Ordinance, which prohibits the sale and use of domestic synthetic detergents containing phosphorus, was enforced in Shiga Prefecture in July, 1980. Before and after the enforcement of the ordinance, variations of the amount of linear alkylbenzenesulfonate (LAS) in rivers flowing into Lake Biwa have been investigated with the following results. The amount of C12-LAS remained constant or slightly decreased after the enforcement of the ordinance. For example, at Hyota River, the amount of C12-LAS remained constant but the T-P amount decreased. This means that the inhabitants of the drainage changed their detergents from ones containing phosphorus to phosphorus-free ones. A correlation coefficient of 0.941 exists between C12-LAS and ignition loss of the river sediment. Thus, the remaining LAS seems to have some relation to the organic matter. The relative abundances of C13-LAS and C14-LAS in the total LAS (e.e. C10 through C14-LAS) in the river sediment were higher than those in the river water. (Author's abstract)
W84-04167

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

EFFECTS OF INSTREAM FLOW REQUIREMENTS ON WATER SUPPLY RELIABILITY: THE CEDAR/TOLT SYSTEM AS A CASE STUDY,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. M. Snyder, R. N. Palmer, and D. P. Lettenmaier.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 169424, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Technical Report No. 83, December, 1983. 135 p, 20 Fig, 6 Tab, 70 Ref, 2 Append. Project No. OWRT A-117-WASH (1), Contract/Grant No. 14-34-0001-2151.

Descriptors: *Instream flow requirements, Reliability, Water supply, *Monte-Carlo simulation, System performance, Model studies, *Washington, Seattle, *Municipal water supply.

The determination of water supply performance, when instream flow requirements for fish are place on a municipal water supply, was studied. A summary of the procedures used to establish instream flow requirements (IFR) is presented in which the procedures are reviewed relative to their major assumptions, data requirements, potential uses, and potential shortcomings. It is concluded that simplified procedures, such as statistical methods, should only be used for cursory investigations and that quasi-habitat models should be used when significant potential impacts exist. To illustrate the impact of water supply system performance of IFR, a case study of the Seattle water supply system is presented. The case study involves the use of a computer simulation model, together with synthetic streamflow sequences, to investigate the indices of system performance. Through a series of Monte Carlo simulations, the tradeoffs between the values of IFR and municipal water supply performance are quantified. It is determined that IFR can decrease the performance of the water supply significantly; for the case study presented by an

order of magnitude. The procedure of developing explicit tradeoffs between values of IFR and the performance of water supplies presented in this study, although no panacea, does present a means of estimating the impacts of IFR on municipal use of water before the requirements are adopted.
W84-03582

EVALUATION OF THE UNCERTAINTY IN PREDICTING HYDROLOGIC INPUTS AND THE EFFECT OF UNCERTAINTY ON WATERSHED MANAGEMENT DECISIONS RELATED TO WATER OR SOIL CONSERVATION MEASURES FOR SMALL WATERSHEDS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2A.
W84-03668

ANALYSIS OF CONCEPTUAL DESIGNS FOR REMEDIAL MEASURES AT LIPARI LANDFILL, NEW JERSEY,
GeoTrans, Inc., Reston, VA.
P. F. Andersen, C. R. Faust, and J. W. Mercer.
Ground Water, Vol. 22, No. 2, p 176-190, March-April, 1984. 16 Fig, 6 Tab, 13 Ref.

Descriptors: *Water quality control, *Landfills, *Lipari Landfill, *New Jersey, Cleanup operations, Decision making, Planning, Path of pollutants, Permeability, Mathematical models, Groundwater movement, Drainage, Clay cap.

The Lipari Landfill is a six-acre former gravel pit and industrial chemical dump located in Glouchester county near Pitman, New Jersey. The landfill is constructed in shallow unconsolidated sedimentary material. Of most importance at the landfill is the potential for contaminated groundwater migration in the Cohansey Formation, and subsequent discharge into surface waters. A permeability conceptual design analysis was performed on various remedial measures for the Lipari Landfill, during the two weeks from March 12 through March 26, 1982. The analysis quantified discharge to drains, flow rates to a swamp downstream of the landfill, time required to drain the landfill, and contaminant travel times that would result from the implementation of each of the remedial measures that were suggested for this site. The sensitivity simulations were designed to test a slurry wall, drain location, drain depth and a clay cap. Analytical solutions were designed to analyze water in place, flow through an underlying layer, draining the lower Cohansey, flushing the contaminated area using wells, and convective arrival time of the contaminants to drains. The effect of the slurry wall is to limit flow to the drain. The closer the drain to the landfill, the faster the water level in the landfill will drop. The flow rate for a 30-ft drain converged in time toward a value of 150,000 gpd. The flow rate for a 120-ft drain tended toward 180,000 gpd. The rates for flushing the contaminated zone by injection and pumping wells, as an alternative to draining, will be limited by the maximum head differential between wells. (Baker-IVI)
W84-03762

SPECIFICATION OF OBJECTIVES BY GROUP PROCESSES IN MULTIOBJECTIVE WATER RESOURCES PLANNING,
Department of the Interior, Washington, DC. Office of Water Policy.
J. P. Deason, and K. P. White, Jr.
Water Resources Research, Vol. 20, No. 2, p 189-196, February, 1984. 1 Fig, 1 Tab, 19 Ref.

Descriptors: *Decision making, *Planning, *Irrigation programs, Water resources, Water supply development, Indian reservations.

One weak link in previous attempts to apply multiobjective decision-aiding tools to actual decision problems has been the initial specification of a usable set of objectives. One new aproach to this problem applies findings about group processes to the development of a suitable procedure for generating and structuring ideas. The procedure, in turn, is applied to determine a set of objectives for the selection of a portfolio of water projects. The procedure results in the definition of a set of objectives that is minimal, operational, complete, decomposable, nonredundant, and hierarchically structured. The procedure is demonstrated effectively in the context of an actual problem situation in water resources planning. In order to invest the limited funding available for water projects on Indian reservations as wisely as possible, the development of a decision support system was initiated to assist with water project portfolio selection decisions that are made as part of the annual appropriations cycle. (Baker-IVI)
W84-03816

PERFORMANCE OF LDR MODELS FOR PRELIMINARY DESIGN AND RESERVOIR OPERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Water Resources Research, Vol. 20, No. 2, p 215-224. February, 1984. 6 Tab, 28 Ref.

Descriptors: *Decision making, *Reservoir operation, *Linear decision rule, Maintenance, Planning, Linear programming, Systems analysis, Model studies.

Linear decision rule (LDR) chance-constrained reservoir models have held promise of developing into simple reservoir screening models and of producing reasonable operating policies. Single and multiple LDR models using two release rule structures are examined in the context of a multiple-purpose reservoir operating problem. The LDR models were of questionable value for screening purposes in this instance. As operating policies, computed LDR policies were less efficient than simple alternatives at meeting water supply and minimum storage targets when subject to constraints on available active or control storage capacity. While mathematical simplicity is an advantage of single LDR screening models over some competitors, simplicity is not justification for its use. (Baker-IVI)
W84-03819

IMPROVING WATER UTILITY MANAGEMENT,
Cincinnati Univ., OH. Dept. of Mechanical and Industrial Engineering.
R. L. Shell, and N. A. Damachi.
Water Engineering and Management, Vol. 131, No. 2, p 42-44, February, 1984. 10 Ref.

Descriptors: *Utilities, *Management, Computers, Pricing, Forecasting, Planning, Water supply, Data processing.

Three major areas of concern exist in the current water utility management industry. One of these in the plethora of federal legislation which has created a tremendous need for data collection and storage. Secondly, there are deteriorating conditions in many older urban water systems, treatment facilities, pumping stations and underground distribution systems resulting in energy waste and creating a potential for public health problems. Thirdly, there is a need to provide for more efficient water delivery as energy, labor, and material costs continue to escalate. These needs are being met through use of computers and systems analysis planning. (Baker-IVI)
W84-04005

GUIDELINES FOR CLOUD SEEDING TO AUGMENT PRECIPITATION.
For primary bibliographic entry see Field 3B.
W84-04041

6B. Evaluation Process

WATER FOR SYNFUELS DEVELOPMENT: PROBLEMS IN ACQUISITION AND DEVELOPMENT,
Varanesh, Raisch, and Schroeder, Boulder, CO.
G. Vranesh, and E. Riordan.
Natural Resources Lawyer, Vol. 16, No. 3, p 439-468, 1983. 162 Ref.

Descriptors: *Synfuels, *Water supply development, *Resources development, *Legal aspects, Energy, Fuels, Colorado River, River basins, Natural resources, Equitable apportionment, Water rights.

Water supply limitations may constrain the development of the abundant energy resources located in the western portion of the United States since the development processes (extraction, transportation, milling), and the population growth generated by such development all demand sizable quantities of year-round water supply. Issues that a synfuels development company should investigate thoroughly in acquiring the necessary rights to satisfy its water requirements are discussed. Water developers must be prepared to take a comprehensive look at the entire Colorado River system to ensure that a firm long-term supply of water is acquired. The water developer cannot limit the analysis to the water-right priority granted pursuant to state water law. Rather, the developer must also examine all other nonstate water-law constraints, including the law of the river, the federal reserved water rights doctrine, the doctrine of equitable apportionment, and federal environmental laws. (Baker-IVI)
W84-03534

PRICING AND CONSERVATION OF IRRIGATION WATER IN TEXAS AND NEW MEXICO,
Texas A and M Univ., College Station. Water Resources Inst.
J. R. Ellis, R. D. Lacewell, G. C. Cornforth, and P. W. Teague.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 169440, Price codes: A06 in paper copy, A01 in microfiche. Technical Report No. 125, October, 1983. 110 p, 22 Fig, 13 Tab, 55 Ref, 1 Append. Project No. OWRT C-90080-C (0486)(1), Contract/Grant No. 14-34-0001-486.

Descriptors: *Water conservation, *Demand, Irrigation water, *Water pricing, *Cropping patterns, *Community impact, Surface water, Groundwater, El Paso, *Texas, New Mexico, High Plains, Ogallala Aquifer.

Two possible policy alternatives for management of limited water suplies in arid portions of Texas and New Mexico were analyzed for economic feasibility. Detailed studies of the potential impact of a water accumulation policy for each of two irrigtion districts were undertaken using temporal linear programming techniques. Current cropping practices, soils, groundwater conditions, historical surface water allocations for Elephant Butte Reservoir and evaporation rates were incorporated within the analysis. Estimates of the benefits of accumulation of surplus portions of irrigation district member's annual surface water allocations, with subsequent use of the unevaporated portion in later years, were deemed insufficient to cover anticipated administrative costs of implementing the proposed policy. This suggests current allocations approximate a temporal optimum. Additional analysis of possible price-induced water conservation for the areas within the two states currently mining groundwater from the exhaustible Ogallala Aquifer was also undertaken. The High Plains of Texas served as the representative region of study, with results assumed to be analogous for the portions of Eastern New Mexico relying on the Ogallala. Both static and temporal effects of a per unit tax on water pumpage and net returns were examined using a recursive linear programming model. Results indicated that imposition of a $20 per acre-foot tax on water pumped induced very little change in water use over a 40 year period, while reducing the present value of producer net returns from 9% to 27% depending upon initial groundwater conditions and the irrigation technology in use. These results imply that a price-induced water conservation policy for the Ogallala is not economically justified.
W84-03570

WORK PLAN FOR THE SANGAMON RIVER BASIN, ILLINOIS,

Geological Survey, Urbana, IL. Water Resources Div.
J. K. Stamer, and D. M. Mades.
USGS Open-File Report 82-693, 1983. 26 p, 3 Fig, 5 Tab, 22 Ref.

Descriptors: *Suspended sediments, *Pesticide residues, *Oxygen balance, *Flood routing, *Nutrients, *Agricultural runoff, Sangamon River, *Illinois.

The U.S. Geological Survey, in cooperation with the Division of Water Resources of the Illinois Department of Transportation and other State agencies, recognizes the need for basin-type assessments in Illinois. This report describes a plan of study for a water-resource assessment of the Sangamon River basin in central Illinois. The purpose of the study would be to provide information to basin planners and regulators on the quantity, quality, and use of water to guide management decisions regarding basin development. Water quality and quantity problems in the Sangamon River basin are associated primarily with agricultural and urban activities, which have contributed high concentrations of suspended sediment, nitrogen, phosphorus, and organic matter to the streams. The impact has resulted in eutrophic lakes, diminished capacity of lakes to store water, low concentrations of dissolved oxygen, and turbid stream and lake waters. The four elements of the plan of study include: (1) determining suspended sediment and nutrient transport, (2) determining the distribution of selected inorganic and organic residues in streambed sediments, (3) determining the waste-load assimilative capacity of the Sangamon River, and (4) applying a hydraulic model to high streamflows. (USGS)
W84-03604

TUG HILL AQUIFER: A COMMUNITY INVOLVEMENT AND EDUCATION PROGRAM PLAN.
Report, Temporary State Commission on Tug Hill, Watertown, NY., August, 1982. 45 p, 6 Fig, 2 Tab, 1 Ref, 2 Append.

Descriptors: *Aquifers, *Groundwater management, *Regional planning, *Policy making, *Public participation, Economic impact, Groundwater storage, Public policy, Groundwater movement, Industrial water, Groundwater pollution, Water supply.

The Tug Hill Aquifer is a major regional groundwater resource vital to the economy and quality of life in the southern portion of the Tug Hill region in New York. The aquifer has a large storage capacity that stretches from the Salmon River basin in Oswego County into Jefferson County in the north and Oneida County in the southeast. The Temporary State Commission on Tug Hill has prepared a study proposal for a two-year project to gain information and to investigate policy options for the aquifer. This Program Plan will be used by the Salmon Rivers Cooperative Planning Board/Conservation Advisory Council to inform and involve communities and citizens in the Tug Hill Aquifer study area in the assessment of the physical aspects of the aquifer and related resources, in the development of management tools, and in the assessment and development of appropriate groundwater management strategies. Two community involvement and education plans are included in the Program Plan, one assuming full funding, the other assuming partial funding. Both plans contain the same three elements: (1) a community involvement and education program plan that details aquifer education projects and a time schedule for their implementation; (2) a recommended agenda for Planning Board participation in the development of education projects; and (3) a model agenda to Town Board/Planning board discussion. (Fazio-Omniplan)
W84-03659

PORTS AND HARBORS TECHNICAL REPORT.
New England River Basins Commission, Boston, MA.
Volume 3, September, 1981. 198 p, 10 Fig, 19 Tab, 2 Append.

Descriptors: *Port authorities, *Harbors, *Port facilities, *Marinas, *Piers, *Regional planning, *Long-term planning, Docks, Regional development, Economic aspects, Economic growth, Economic impact, Cargoes, Containerization.

The overall effectiveness of New England's port system, and its ability to accommodate varied development pressures within a confined space, are evaluated relative to: regional economy, trade, and port cargo trends and potentials; port institutions; and potential regional trends in harbor development. Reflecting the nonmanufacturing based economy of the region, New England ports have handled declining volumes of cargo throughout the past decade. Petroleum remains the largest volume cargo, with a diversity of other bulk and neo-bulk cargoes being important regional port business. The impact of containerization has centralized and diverted regional flows of general cargo. Prospects for the future indicate stable trade levels, with the possible exception of some growth in container movements through a few New England ports, and the reintroduction of domestic coal receipts in many regional harbors. Capacity utilization varies throughout the region. The highest, 88%, occurs in Bridgeport, while some facilities are rarely used for cargo-handling purposes. Common-user marine terminals account for approximately 13% of all regional port facilities. The container facilities in Boston are the only dedicated, special purpose, common-user terminals in the region. Many of the region's ports are served by narrow finger piers and small backup areas which tend to limit operations to traditional break-bulk cargoes. The institutions that own common-user facilities include private, state and local governments. (Garrison-Omniplan)
W84-03681

OPTIMAL CONTROL PROBLEMS IN TIDAL POWER,
Reading Univ. (England). Dept. of Mathematics.
For primary bibliographic entry see Field 8B.
W84-03726

EVALUATION OF URBAN RIVERSCAPE AESTHETICS IN THE CANADIAN PRAIRIES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
J. W. Pomeroy, M. B. Green, and J. E. Fitzgibbon.
Journal of Environmental Management, Vol. 17, No. 3, p 263-276, October, 1983. 3 Fig, 3 Tab, 32 Ref.

Descriptors: *Planning, *Aesthetics, *Canada, *Urban areas, *Rivers, Management planning, Evaluation, Recreation, Vegetation, Land use, Scenery.

Perception of an urban riverscape is measured, using unbiased differentiation of riverscape photographs by 30 University of Saskatchewan students from various backgrounds and disciplines. Multidimensional scaling of the resultant similarity matrix revealed three cognitive constructs (dimensions) used to evaluate the riverscape. Cluster analysis of the matrix developed clusters of photographs which were plotted on the three dimensions. The common attributes of the photographs in the clusters are those significant to landscape evaluation, their effect assessed in the context of the regional landscape. Attributes eliciting strong responses are color, vegetation, soil exposure, land use, blight and cultural features. The methodology developed is not directed towards preferred landscapes, but towards evaluation of landscapes in a specific regional context. (Baker-IVI)
W84-03771

IMPLEMENTING THE PARITY PROMISE: AN EVALUATION OF THE COLUMBIA BASIN FISH AND WILDLIFE PROGRAM,
Lewis and Clark Coll., Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law, Vol. 14, No. 2, p 277-358, 1984. 334 Ref.

Descriptors: *Legal aspects, *Wildlife management, Fish and Wildlife Program, Columbia River Basin, River basins, Rivers, Columbia River, Environmental impact statement.

The Pacific Northwest Electric Power Planning and Conservation Act promised parity for the Columbia Basin's fish and wildlife in the planing and operation of the Federal Columbia River Power System. The Act established the Northwest Power Planning Council and directed the Council to formulate an unprecidented restoration program to compensate for past and ongoing fish and wildlife losses attributable to the Nation's largest hydroelectric system. The Fish and Wildlife Program is evaluated, assessing its prospects for restoring the once bountiful salmon and steelhead runs of the upper Columbia Basin, and some of the implementation difficulties that have confronted the Program since its approval. The fish and wildlife innovations of the Northwest Power Act include full compensation for fish and wildlife losses, off-site enhancement, ratepayer financing, and changed burdens of proof. The process that Congress established for approving the Program is explained. Specific fish and wildlife measures approved by the Council are evaluated and difficulties encountered in funding some of the measures called for by the Program are reviewed. While the Program represents a pathbreaking commitment to preserve and restore the Columbia Basin's fish and wildlife, it could be improved if the Council adopted certain program amendments and if Congress passed legislation to speed implementation. (Baker-IVI)
W84-03861

DEVELOPMENT OF WELLS IS VITAL,
Water Research Centre, Marlow (England).
L. Clark.
The Johnson Drillers Journal, Vol. 55, No. 3/4, p 12-14, 1983. 1 Fig, 7 Ref.

Descriptors: *Wells, *Water supply development, Evaluation, England, Pump wells, Decision making, Aquifer characteristics, Permeability, Seepage.

Laboratory scale experiments can serve a useful role in evaluating well behavior. Such tests show that hydraulic losses across well screens alone are negligible. Well losses, in the main, take place in the aquifer or in gravel pack adjacent to the well screen. Irrespective of the negligible losses across the screen, well-losses become significant in field situations when the screen open areas fall below about 10%. Aquifer invasion by drilling fluid, including drilling water alone, can seriously reduce the permeability of the aquifer around the well. Such permeability reduction will lead to excessive losses and drawdown in the well if the invasion is not reversed. Well development leading to full recovery of aquifer properties adjacent to the well can be extremely difficult to achieve. (Baker-IVI)
W84-03953

COOPERATIVE SEPARATISM MARKS RALEIGH'S WATER/WASTEWATER OPERATIONS,
Feinschreiber and Associates, Miami, FL.
P. Hersch.
Water Engineering and Management, Vol. 131, No. 2, p 19 and 49, February, 1984. 1 Fig.

Descriptors: *Management, *Utilities, *Water treatment, *Wastewater treatment, *Raleigh, *North Carolina, Computers, Decision making, Planning.

At Raleigh, North Carolina, the management of the Department of Public Utilities has opted to integrate wastewater and water services to the extent of acting cooperatively where possible, yet functioning with defined, independent budgets and sources of revenue. Management of combined water/wastewater facilities faces a special issue; the interaction of the two units. Management philosophy establishes revenue and expense procedures, but time management sets a utility's organization, management style and division of labor. Being well structured with many of the budgetary and utility charges being handled by computer frees management to plan and prepare for the

future. The utility currently has 52 projects under contract with consultants. One completed project is now returning dividends under an unusual land-use program, which brings in $350,000 per year. (Baker-IVI)
W84-04003

MINI AND MICROHYDRO IN GUJARAT,
Gujarat Irrigation Dept., Gandhinagar (India).
J. F. Mistry.
International Water Power and Dam Construction, p 23-24, February, 1984. 1 Fig, 3 Tab.

Descriptors: *Developing countries, *Water resources development, *Hydroelectric plants, *India, *Gujarat, Mahi River, Tapi River, Narmada River, Planning.

Hydro resources of Gujarat are limited as there are only three major rivers: the Tapi, the Narmada and the Mahi, all of which are interstate rivers with the problems of sharing the power potential. Mini and micro developments are subjected to variable stream inflows as well as seasonal variations in the availability of water, such as is to be expected at dam outlets and canal drop sites. Priority must be given to the development of sites where discharge rates are reasonably continuous over fairly long periods, and where harnessable drops are available. Nine mini hydro schemes have been identified in Gujarat, the details of which are tabulated. The total feasible hydropower potential of the state is 1247 MW. (Baker-IVI)
W84-04073

CALCULATING DESIGN DISCHARGES FOR SMALL-SCALE HYDRO STATIONS,
Energoprojekt, Sofia (Bulgaria).
M. Angelov.
International Water Power and Dam Construction, p 25-26, February, 1984. 1 Tab.

Descriptors: *Hydroelectric plants, *Decision making, Planning, Design criteria, Evaluation.

The economic and technical advantages of small scale hydro plants are often misunderstood because the assessment methods used are inappropriate. A different approach is offered which leads to a better appreciation of the value of these small plants. The role of the small stations should not be to cover power deficiencies but to provide optimum electric energy generation and thereby save fuel for thermal stations or reduce imported electric energy. The incompatibility between small-scale hydro plants and the system approach of large-scale hydro stations necessitates a specific criterion for the energy effectiveness of the small stations. Principles of multipurpose optimization are used to set up criterion upon which to base judgements. (Baker-IVI)
W84-04074

DEVELOPING SMALL-SCALE HYDRO IN CZECHOSLOVAKIA,
Office of the Czechoslovak Federal Premier, Prague.
F. Pazout.
International Water Power and Dam Construction, p 37-38, March, 1984. 5 Fig.

Descriptors: *Hydroelectric plants, *Powerplants, *Water resources development, *Czechoslovakia, Planning, Energy, Economic aspects.

A vigorous program is being implemented in Czechoslovakia to encourage the development of small-scale hydropower, including financial incentives and free expert advice. By 1985 construction will have been gradually started on seven small-scale hydro stations totalling 15.96 MW capacity and 71.1 GWh. In the following five year period the government will arrange for construction of 28 mini hydro stations with an aggregate capacity of 62.35 MW and an output of 271.43 MWh. In addition there are also plans for a large number of refurbished and newly built mini hydro plants with a capacity of 60 kW each and household installations under 35 kW each operated by individuals. It is a great advantage that the full electrification of Czechoslovakia facilitates the connection of new powerplants to the grid, and consequently the full exploitation of their capacities, which favorably influences their economic value. (Baker-IVI)
W84-04081

SUPPLEMENTAL IRRIGATION STORAGE RELIABILITY,
Kansas State Univ., Manhattan.
J. M. Steichen, and J. J. Zovne.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 35-45, March, 1984. 10 Fig, 2 Tab, 17 Ref. OWRT project B-059-KAN.

Descriptors: *Supplemental irrigation, *Simulation, *Moisture deficiency, *Kansas, *Reliability, Storage ponds, Watersheds, Precipitation, Temperature, Computer models, Irrigation demand.

Small on-farm supplemental irrigation systems are increasingly being used in sub-humid and humid regions to stabilize farm income and to increase farm productivity. A computer simulation model is used to evaluate the risk of having insufficient water for supplemental irrigation. The model simulates the daily operations of a system consisting of a watershed, pond, and irrigation plot. Daily precipitation and temperature data, which drives the hydrologic functions, is readily obtained from National Weather Service archives. At least 25 years of data is used to determine the frequency of failure of the storage pond to deliver water when there is an irrigation demand. Supplemental irrigation simulations were made for five stations in eastern Kansas (Ft. Scott, Independence, Horton, Manhattan, Belleville). Generalized system reliability curves are generated for moisture deficits ranging from 219-582 mm (8.6-22.9 in.). Moisture deficits increase significantly moving from Ft. Scott in southeastern Kansas to Belleville in central Kansas. Supplemental irrigation becomes less viable with increasing moisture deficit, but may be very important to sustain production. The model is useful for designing an individual system or for establishing design guidelines for a region. (Moore-IVI)
W84-04092

TECHNIQUES FOR DETECTING TRENDS IN LAKE WATER QUALITY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W84-04103

OPERATION OF A TWO-WELL SYSTEM FOR THE CASES OF COMPETITION AND COOPERATION (EXPLOITATION D'UN SYSTEME DE DEUX PUITS EN SITUATION DE COMPETITION ET EN SITUATION DE COORDINATION),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
P. Hubert.
Journal of Hydrology, Vol. 70, No. 1-4, p 353-367, 1984. 9 Fig, 1 Tab, 8 Ref.

Descriptors: *Water supply development, *Evaluation, *Wells, Management, Economic aspects, Mathematical equations, Competition, Cooperation, Exploitation.

Two different ways of exploiting a two-well system in steady state are studied. In one case, competition, two different economical agents manage one well each. In the other case, coordination, both of the wells are managed by the same economical agent. These problems are special cases of an oligopoly game. The hydrogeologic conditions are assumed to be favorable for groundwater exploitation in each case and the only limiting factor is economic origin. An equilibrium is always reached in both cases, but in the case of coordinated exploitation, at least one of the wells is operated at a lower production rate than in the case of competitive exploitation. A numerical application is made on a simplified example. (Baker-IVI)
W84-04161

HYDRO PLANT UPGRADED FOR HIGHER OUTPUT AND REMOTE OPERATION,
Burns and McDonnell, Kansas City, MO.
D. Lord.
Power Engineering, Vol. 88, No. 3, p 55-56, March, 1984. 1 Fig, 2 Tab, 1 Ref.

Descriptors: *Powerplants, *Water resources development, Turbines, Computers, Generators, Gantt Dam, Covington County, Alabama.

A statewide survey conducted by the Alabama Electric Cooperative identified an old hydroelectric facility on the Gantt Dam and Reservoir as a potential candidate for rehabilitation and upgrading. Through computer modeling of the site, it was determined that the installation of new equipment would provide a more efficient use of available energy resources. Units 1 and 2 were replaced with a single new unit and unit 3 was upgraded. The new unit consists of a vertical fully-adjustable propeller turbine with a wicket gate assembly. When operational, the generation of the system will increase from 8,200,000 kWh per year to an excess of 9,800,000 kWh per year. (Baker-IVI)
W84-04179

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

IMPROVING WATER UTILITY COST CONTROL,
Consultants to Management, Inc., Providence, RI.
W. T. Gardner, Jr.
Journal of the New England Water Works Association, Vol. 97, No. 4, p 334-342, December, 1983.

Descriptors: *Budgeting, *Utilities, *Costs, *Water distribution, Economic aspects, Cost analysis, Management.

Planning, budgeting, monitoring and reporting of all financial segments of an organization to maximize the assets used in the operations at the lowest possible cost and greatest efficiency is the operating definition given for cost control. The key factor to internal cost control is a budget. External cost control involves vendor price increases, availability of parts, weather, street cave-ins, banking relationships, and other areas where control is limited. More control can be exercised internally and specific areas to be considered include billings, accounts receivable, inventory, purchasing, labor costs and materials costs. (Baker-IVI)
W84-03793

INSTRUMENTAL PRICE ESTIMATES AND RESIDENTIAL WATER DEMAND,
Denver Univ., CO. Dept. of Economics.
C. V. Jones, and J. R. Morris.
Water Resources Research, Vol. 20, No. 2, p 197-202, February, 1984. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Pricing, *Water demand, Residential, Mathematical models, Water rates, Water use, Denver, Colorado.

When a commodity is sold at a schedule of rates depending on the quantity consumed, econometric analysis must consider questions not encountered for goods offered at uniform prices. Instrumental estimates of two price specifications, one motivated by the consumer decision problem given full information about rates and charges and the other an average price formulation, are developed to correct for measurement error when residential water sales are made at a schedule of rates, rather than at uniform prices. Annual water purchases of single-family residences are regressed on these instrumental price estimates, family income, and household size by ordinary least squares, based on a sample of 326 observations from metropolitan Denver, Colorado, for 1976. The resulting demand estimates are robust to the price concept specified, given proportional variation in all rates and charges, and are consistent with findings in the literature. The overall price elasticity estimate range between -0.14 in a linear model to -0.44 in

log-log model, while the estimated income elasticity varies between 0.40 and 0.55. (Murphy-IVI)
W84-03817

6D. Water Demand

GROUND-WATER RESOURCES AND GEOLOGY OF DODGE COUNTY, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03651

GROUND-WATER RESOURCES, CUMBERLAND COUNTY, NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03682

GEOLOGY AND WATER RESOURCES OF THE WHARTON TRACT AND OF THE MULLICA RIVER BASIN IN SOUTHERN NEW JERSEY,
Geological Survey, Trenton, NJ. Water Resources Div.
E. C. Rhodehamel.
Special Report No. 34, New Jersey Dept. of Environmental Protection, 1973. 58 p, 15 Fig, 9 Tab, 65 Ref.

Descriptors: *Aquifer characteristics, *Potential water supply, *River basins, *Surface-groundwater relations, Dissolved solids, Acidic water, Long-term planning, Rivers, Basins, Gaging stations, Gaging streams, Water quantity.

Unlike many land acquisitions for water-supply purposes, the Wharton Tract in southern New Jersey was purchased by the state prior to area needs. Population and industrial trends and estimates of the water-supply reserves within present service areas for Camden and Atlantic City suggest that near-maximum utilization of the tract's water-supply potential may not be needed before 2000 A.D. Principal aquifers are in the Kirkwood Formation, Cohansey Sand and in overlying hydraulically connected deposits of Quaternary age. Ground water and surface water in the Mullica River basin are low in dissolved solids, generally less than 50 mg/l. Iron concentrations are generally high, up to 49,000 micrograms per liter in ground-water and up to 7,100 micrograms per liter in the streams. The water is acidic, as indicated by typical pH values of from 4.5 to 6.5. Color of the surface water is commonly high, ranging from 3 - 150 platinum-cobalt units. After appropriate treatment these waters are acceptable for most uses. Mean discharge from the 180.6-square mile area is 202 mgd, or 1.12 mgd per sq. mile. The Wharton Tract is well situated to support the growing water needs of nearby communities. Maximum water development can be achieved by conjunctive use of ground and surface water. It is estimated that 70 mgd of water could be developed with minimal effect upon low flows in the half of the tract above the gaging stations on the Mullica and Batsto Rivers. (Garrison-Omniplan)
W84-03686

APPRAISAL OF WATER RESOURCES IN THE UPPER VERDE RIVER AREA, YAVAPAI AND COCONINO COUNTIES, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03689

ESTIMATED IRRIGATION WATER USE IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-03696

COMPARISON BETWEEN THE PROBABILITY AND SIMULATION PROCEDURES FOR STORAGE ANALYSIS,
Monash Univ., Clayton (Australia).
R. M. Phatarfod.
Journal of Hydrology, Vol. 69, p 29-41, 1984. 6 Tab, 20 Ref.

Descriptors: *Comparison studies, *Probabilistic process, *Simulation analysis, *Water storage, Water supply, Water demand, Water requirements, Mathematical models, Markov flows, Dams, Yarra River, Victoria, Australia.

During the past 25 years or so, two classes of methods have been introduced to study the relationship between reservoir size, demand of water and reliability of supply. Two simulation procedures and three probability procedures for determining the size of a reservoir required to meet a certain demand of water are compared. A case-study of the river Yarra, in Victoria, Australia, is given and the probability of emptiness of the dam obtained by using all the five methods. The input model considered is that of seasonally dependent first-order Markov flows. The probability procedures applicable for such an inflow model are the (numerical) probability matrix procedure and two analytical procedures which assume the dam to be bottomless. All the probability procedures involve discretization of the problem, and for reasonable accuracy, the unit of measurement need not be small. This means that the matrices involved need not be large and the computational problem is quite manageable. The analytical procedures, while not being quite appealing to the engineer, have the advantage that through their use it would be possible to derive algorithms for working out dam sizes, which make use of only the annual flow parameters and the seasonal transitional probabilities. (Murphy-IVI)
W84-03775

COMPETITION FOR WATER,
J. P. Smith.
The Johnson Drillers Journal, Vol. 55, No. 3 & 4, p 8-11, 1983. 2 Fig.

Descriptors: *Water use, *Water resources development, *Water management, Water quality, Water supply development, Public health, Energy, Conservation, Recycling.

Nearly 150 of the world's major river basins are claimed or shared by two or more countries. Nearly half the people in the world live in the Third World nations without adequate sanitation facilities. Nearly 80% of all disease and sicknesses such as malaria, schistosomiasis and typhoid are the result of substandard water or sanitation. Two major conflicts surrounding water development dominate water politics in the American West: plans to divert water from northern to southern California, and the competition between coal developers and other interest groups in the northern Great Plains. Conservation is a critical water management tool, and a potential 'new' water source. Two areas where there may be opportunities for substantial water savings are more efficient irrigation techniques and large-scale wastewater recycling. (Baker-IVI)
W84-03952

6E. Water Law and Institutions

PROTECTION UNLIMITED: A PREFERRED USER'S RIGHT TO MEANS OF GROUNDWATER DIVERSION IN NEBRASKA,
S. S. Gealy.
Nebraska Law Review, Vol. 62, No. 2, p 270-315, 1983. 266 Ref.

Descriptors: *Well interference, *Groundwater diversion, *Preferred users, *Nebraska, Legal aspects, Water rights, Reasonable use, Ownership of water, Prior appropriation.

Well interference takes place when the cones of depression of two or more wells overlap. The current state of the law in Nebraska is considered as it relates to rights and liabilities in well interference disputes. Certain suggestions are set forth whereby the current law may become more effective. Applicable legal doctrines considered include the English Rule of Absolute Ownership, the American Rule of Reasonable Use, the Restatement Position, and the Doctrine of Prior Appropriation. When the legislative channels for dispute avoidance do not prove sufficient and well interference cases come before the Nebraska Supreme Court, it must decide the controversies through expanding the common law rules to include a balancing of the interests involved in each case. (Baker-IVI)
W84-03535

WATER POLLUTION LAWS: CAN THEY BE CLEANED UP,
Haight, Gardner, Poor and Havens, Washington, DC.
S. A. Wallace, and T. L. Ratcliffe.
Tulane Law Review, Vol. 57, No. 5, p 1343-1367, June, 1983. 157 Ref.

Descriptors: *Water pollution control, *Cleanup operations, *Liability, *Compensation, *Oil spills, Costs, State jurisdiction, International law.

Existing laws of the United States are surveyed as they pertain to oil pollution liability and compensation, and payment for cleanup costs, including the Federal Water Pollution Control Act, Shipowner's Limitation of Liability Act, Trans-Alaska Pipeline Authorization Act, Deepwater Port Act, and Continental Shelf Lands Act. Efforts underway both domestically and internationally that are intended to increase uniformity in the law pertaining to these aspects of oil pollution are considered. The system of liability and compensation for oil spills as it exists in the United States today is ineffective, inefficient, and inequitable. Federal law displays excellent features in spots, but lacks comprehensiveness and uniformity. Each of the several states seeks its own solution. The victim of pollution and the public suffer. Adoption of a comprehensive federal scheme with a domestic fund wrapped around the international Conventions will serve many ends, all constructive. (Baker-IVI)
W84-03546

REPORT OF THE RIVER MASTER OF THE DELAWARE RIVER FOR THE PERIOD DECEMBER 1, 1981 - NOVEMBER 30, 1982,
Geological Survey, Trenton, NJ. Water Resources Div.
For primary bibliographic entry see Field 4A.
W84-03578

HISTORICAL/CULTURAL FACTORS AFFECTING SOUTH CAROLINA WATER LAWS AND POLICIES AND THEIR RELATIONSHIPS TO PRESENT LAWS AND POLICIES,
Clemson Univ., SC. Dept. of History.
F. Steirer, Jr.
Available from the National Technical Information Service as PB84-154418, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Institute, Publication No. 114, September, 1983. 156 p, 283 Ref. Project No. OWRT A-048-SC (1), Contract/Grant No. 14-34-0001-9043, 14-34-0001-1143, 14-34-0001-0143, 14-34-0001-2143.

Descriptors: *South Carolina, *History, *Water law, *Riparian rights, *Water policy, *Policy making, *Political aspects, Administrative decisions, Common law, Drainage, Evolution, Ground water, Legislation, Marshes, Mill dams, Property rights, Reclamation, Social costs, Social values, Water rights, Urbanization, Water allocation, Water use, Dams.

The purpose of this study is to examine the historical development of water law and policy in South Carolina in order to determine why the present water quantity situation exists. During the first period of South Carolina history until 1825, a rudimentary form of prior appropriations functioned with the legislature doing the allocating. From 1825 to 1840, riparian doctrine grew out of

the failure to establish a system of internal improvements and the growing commitment to individual values which in water law were enscribed in riparianism. The period 1840 to 1955 saw a refining of what essentially was a static doctrine, kept in a stagnant condition by the presence of deep-seated 'truths' that operated in South Carolina. After 1953, what has happened is the gradual demise of riparianism because of interbasin transfers. In the 1980's, South Carolina does not appear to be prepared to accept legal doctrine that seem to challenge the legality of long-held riparian rights. Instead, the historical record seems to suggest that small, carefully designed revisions incorporating the recommendations of a recent Water Law Review Committee will be more successful. The 'truths' that helped keep water law from evolving earlier have probably lost some of their influence, although a variety of attitudes, both positive and negative, have been and continue to be present in South Carolina affecting water law and policy.
W84-03665

SUMMARY OF NEW YORK WATER LAW,
Cornell Univ., Ithaca, NY. Law School.
J. B. Bugliari, and L. Cappalli.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 154368, Price codes: A03 for paper copy, A01 for microfiche. Center for Environmental Research Completion Report, February, 1984. Project No. OWRT A-009-NY (1), Contract/Grant No. 14-34-0001-2134.

Descriptors: *Water law, *New York, Private water rights, Underground water rights, Surface water rights, *State regulation, *Water rights, *Land tenure, *Property rights, *Riparian rights.

A summary is presented of the law affecting private water rights in the state of New York: 'Part I. The Rights of the Landowner' deals with the ways in which private landowners may use the waters on or flowing through their property and the lands adjacent to these waters. Part I breaks down the law affecting water according to the nature of the water involved, that is, water flowing in a defined channel (watercourse) and water not flowing in a defined channel (surface water and percolating groundwater). 'Part II. State Regulation of Landowner's Rights' briefly examines statutory limitations that the state has imposed on landowners to restrict the way in which they may use their waters or lands. Private landowners are not the absolute owner of their property. All property rights arise from the state and may be restricted or taken by the state. Because the state has a strong interest in preserving and promoting its water resources, it often acts so as to affect the traditional rights of landowners to use their lands and the waters on or adjacent to them.
W84-03692

FEDERAL PLAN FOR MITIGATION OF ACID PRECIPITATION EFFECTS IN THE UNITED STATES: OPPORTUNITIES FOR BASIC AND APPLIED RESEARCH,
R. K. Schreiber, and P. J. Rago.
Fisheries, Vol. 9, No. 1, p 31-36, January-February, 1984. 1 Tab, 36 Ref.

Descriptors: *Planning, *Mitigation, *Acid rain, *United States, Environmental effects, Rehabilitation, Acidic water, Water pollution treatment, Fisheries.

The Acid Precipitation Act of 1980 authorized formation of a government-wide interagency task force to develop a National Acid Precipitation Assessment Plan (NAPAP). One of the objectives of NAPAP is the development of mitigation measures for aquatic ecosystems. Given the potential magnitude of the problem and the complexity of its solution, mitigation methods play an important role in protection of fish populations at risk and in rehabilitation of acidified systems to restore fishery productivity. The term 'mitigation' usually connotes application of lime or other base materials to affected surface waters. Mitigation, however, encompasses a much broader range of treatments, including creation of favorable micro-habitats for selected life stages, application of other acid-neutralizing and ligand materials, development of resistant fish strains, and stimulation of biologically-produced alkalinity. Development of mitigation methods should be viewed not only as a response to a pressing national need, but also as a unique opportunity for basic and applied research extending to many areas of fishery science. An active research program on mitigation methods and strategies can provide much insight into the structure and functioning of aquatic system undergoing acidification. (Author's abstract)
W84-03812

POLLUTED GROUNDWATER CLEARLY A PROBLEM, BUT FEW AGREE ON EXTENT OR SOLUTION,
For primary bibliographic entry see Field 5C.
W84-03869

RHODE ISLAND IMPOSES STRICT LIABILITY FOR CONTAMINATION OF WATER BY PERCOLATION OF POLLUTANTS FROM ILLEGAL DUMP SITE,
E. L. Hand.
Natural Resources Journal, Vol. 23, No. 3, p 697-703, July, 1983. 24 Ref.

Descriptors: *Water pollution sources, *Percolation, *Dumps, *Rhode Island, *Liability, Organic compounds, Legal aspects, Industrial wastes.

In general, negligence need not be proved in a nuisance case because the original nature of the defendant's conduct becomes unimportant if the defendant, once notified of the nuisance, fails to eliminate the problem. The Rhode Island Supreme Court ruling, in a case against the operators of an illegal chemical dump, abolished the negligence requirement for a nuisance involving percolating waters. The court was aware of the great need for strict water pollution standards and would not tolerate as serious a nuisance as this situation was. However, in general the courts are not yet willing to impose strict liability of water pollution because of potential cases in which the adverse economic consequences to the community exceed the actual injuries to specific residents. (Baker-IVI)
W84-03967

ECONOMICS AND THE DETERMINATION OF INDIAN RESERVED WATER RIGHTS,
D. S. Brookshire, J. L. Merrill, and G. L. Watts.
Natural Resources Journal, Vol. 23, No. 4, p 749-765, October, 1983. 62 Ref.

Descriptors: *Water rights, *Economic aspects, *Indian reservations, *Reserved rights, Planning, Decision making, Water supply development, Irrigation.

The role of economics in the determination of Indian reserved water rights is discussed. In addition to discussing why economics is important to Indian reserved water rights, some parameters of an appropriate economic analysis which form a perspective differing with other recent papers on the subject are examined. Some specific economic issues in the reserved rights inquiry are considered. Despite its shortcomings, the concept of practicably irrigable acreage (PIA) probably will continue as a yardstick for Indian reserved water rights in western water planning. Strict and appropriate criteria should be used to quantify the PIA. While ethics is undoubtedly important in the question, such considerations should be applied as a whole by the Court, not individually by each discipline within the PIA inquiry. (Baker-IVI)
W84-03968

WATER LAW - SPORHASE V. NEBRASKA,
M. A. Green.
Natural Resources Journal, Vol. 23, No. 4, p 923-931, October, 1983. 43 Ref.

Descriptors: *Water rights, *Legal aspects, *Nebraska, Water supply, Water shortage, Ogallala Aquifer, Arid regions, Groundwater.

The U.S. Supreme Court's decision in the Sporhase vs Nebraska case holds that a Nebraska statute prohibiting the export of groundwater to a state not granting reciprocal rights to transport water into Nebraska violates the Commerce Clause of the Constitution. The finding that water is an article of commerce has a far-reaching effect on water regulation in the arid western states for two reasons. First, the decision glosses over the public-versus-private ownership distinction of groundwater. Second, while absolute bans on water export have been made virtually impossible, the Court acknowledged as legitimate the conservation component of the statute, even though the conservation requirements applied only to out of state users. After this decision, broad or all-encompassing bans on water export will be nearly impossible to sustain. However, the general framework for the regulation of water supplies in the western states is still intact. (Baker-IVI)
W84-03969

GREAT DRAIN ROBBERY,
For primary bibliographic entry see Field 5B.
W84-03971

ORGANIC CONTAMINANTS IN THE AQUATIC ENVIRONMENT; III. PUBLIC HEALTH ASPECTS, QUALITY STANDARDS AND LEGISLATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W84-03995

GUIDELINES FOR CANADIAN RECREATIONAL WATER QUALITY,
R. S. Tobin, and W. M. Ward.
Canadian Journal of Public Health, Vol. 75, No. 1, p 15-18, January/February, 1984.

Descriptors: *Water Quality, *Standards, *Recreation, Epidemiology, Pathogens, Microbiological studies, Chemical properties, Canada.

It is important to establish criteria to assess the relative risk of man-made environmental hazards on persons who bathe, play and swim in our lakes, rivers or oceans. Health hazards associated with direct recreational contact with water include infestations transmitted by pathogenic microorganisms and other organisms and injuries due to impaired visibility in turbid waters. These guidelines deal mainly with health hazards related to recreational water use but they also relate to esthetics and nuisance conditions. A Sanitary Survey of the watershed should identify, in a case-by-case manner, all potential sources of contamination that could impinge on the bathing area. Keeping an accurate epidemiological record of a recreational area, by collecting any known water-borne infections may indicate when the quality of the water is impaired. The recommended fecal coliform concentrations should not exceed 200/100 mL in a recreationally-used area. The pH of the waters used for total body contact recreation should be in the pH range of 6.5 to 8.5. Standardized methods for microbiological sampling and analysis creates valid results. Alternative procedures are also reliable but consistency is of particular importance. (Murphy-IVI)
W84-04008

CANADA'S LEADING ROLE IN IMPLEMENTING THE UNITED NATIONS PROGRAM ON WATER QUALITY MONITORING,
Canada Centre for Inland Waters, Burlington (Ontario).
S. Barabas.
Canadian Journal of Public Health, Vol. 75, No. 1, p 69-73, January/February, 1984. 2 Tab.

Descriptors: *Water quality, *United Nations, *Canada, Global water quality monitoring, Monitoring, Lakes, Aquifers, GEMS/WATER program.

Since 1977, Canada has played a leading role in developing and implementing the United Nations program for global water quality monitoring, Global Environmental Monitoring System for Water (GEMS/WATER). Close to 200,000 water quality data points have been reported to the Global Data Center in Canada by some 350 monitoring stations located on major rivers, lakes and aquifers in 50 countries. The prerequisite was the development and publication of a comprehensive 'operational guide' covering acceptable methods for selecting water sampling sites; sampling; analysis; hydrological measurements; analytical quality control; and data storage and retrieval. Moreover, training courses in the application of such methods had to be given in all parts of the world. This article deals with the origins, significance and implementation of the GEMS/WATER program. (Author's abstract)
W84-04013

CANADIAN PARTICIPATION IN THE INTERNATIONAL DRINKING WATER SUPPLY AND SANITATION DECADE,
Walker and Partners Ltd., Ottawa (Ontari).
B. Grover.
Canadian Journal of Public Health, Vol. 75, No. 1, p 74-78, January/February, 1984. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Canada, *Water supply development, Water supply, Sanitation, International commissions, International agreements, International Hydrological Decade.

Canada has been an active promoter of the International Drinking Water Supply and Sanitation Decade, whose goal is to provide these basic services to all people in the period 1981-1990. This implies providing improved services to roughly 2,000 million people in the developing countries in ten years, a noble but unattainable goal. However, the Decade could provide a major stimulus to accelerate the provision of services to meet the basic needs of millions of people. Improving public health conditions is the underlying rationale for the Decade. Most of Canada's 25 million people are reasonably well provided with water supply and sanitation. These services are generally provided at the local level by an industry which is highly decentralized and loosely organized. This industry, with an estimated 40,000 employees across the country, has hardly focussed on the opportunities for utilizing Canadian experience and resources to support sector programs in the developing countries. The Canadian International Development Agency continues to provide assistance on a modest scale for a number of activities related to water supply and sanitation projects. Despite nominal support for the Decade, however, there is no evidence that Canada's official development assistance for water and sanitation programs has changed as a consequence of the International Decade. (Author's abstract)
W84-04014

6F. Nonstructural Alternatives

UNIFIED NATIONAL PROGRAM FOR FLOOD PLAIN MANAGEMENT.
Water Resources Council, Washington, DC.
Available from Supt. of Documents, GPO, Washington, D.C. 20402, as S/N 052-045-00058-4. Report to the President and Congress, September, 1979. 89 p, 2 Append.

Descriptors: *Flood plain management, Flood control, Flood protection, Nonstructural alternatives, Water policy, Decisionmaking, Alternative planning, *Flood loss mitigation, *Flood plains preservation, *Flood plain restoration.

This report seeks wise decisions and management for the Nation's floodplains to reduce losses of life and property from flooding and losses of natural and beneficial floodplain values from unwise land use. A conceptual framework is set forth to provide general guidance for the decisionmaking processes of Federal, State, and local officials as well as for private parties. This conceptual framework contains general and working principles that relate riverine, coastal, and other floodplains to the total natural and social systems of which they are a part. It also describes the potential for flood losses and environmental harm associated with the use of floodplains. Each level of government has legal program responsibilities within this framework. The strategies and tools for flood loss mitigation and for the preservation and restoration of natural floodplain values are presented in detail. The means and tools for reducing loss of natural floodplain values are presented in detail. The means and tools for reducing loss of natural floodplain values support four major strategies: (1) avoiding actions that affect adversely the floodplain, whenever there is a practicable alternative; (2) minimizing the adverse impacts of actions that affect the floodplain; (3) restoring previously degraded floodplains to serve their natural functions; and (4) preserving those floodplains whose natural functions are relatively undisturbed. Actions are recommended to facilitate the coordination of management programs dispersed among all levels of governments.
W84-03664

DEVELOPMENT OF A POLICY FOR LEAKAGE CONTROL,
WRC Engineering, Swindon (England).
D. B. Field.
Journal of the New England Water Works Association, Vol. 97, No. 4, p 310-333, December, 1983. 2 Fig, 11 Tab.

Descriptors: *Leakage, *Policy making, Water loss, Pipelines, Reservoirs, Water distribution, Water conveyance, Costs.

Over 500 field experiments or measurements designed to investigate leakage and the various methods of controlling it were carried out in the U.K. Leakage from service reservoirs, trunk mains and distribution systems was measured and the effects of age, diameter and method of construction determined. Also the costs, capital and operating, associated with each method of leakage control were determined together with measurements of the effectiveness of each method at reducing leakage. Data relating to the effects of pressure on leakage, variations in leakage with time and costs of repair were also collected. There was no one method of leakage control appropriate to all distribution systems. A procedure for determining the most appropriate leakgage control policy for any given distribution system has been developed and implemented. Using this procedure it was determined that regular sounding or one-time sounding surveys were economical in only 2% of the systems in the United Kingdom. All others warranted a more intensive method of leakage control. Reduction of distribution pressures by even a small amount can have a significant reduction of leakage levels. Use of the Leak Noise Correlator in conjunction with any method of leakage control will significantly improve the overall efficiency of the operation. (Baker-IVI)
W84-03792

USING VEGETATION FOR NON-STRUCTURAL SEDIMENT CONTROL,
Land-Tech Consultants, Inc., Ridgefield, CO.
R. J. Jontos, Jr., and C. P. Allan.
Public Works, Vol. 115, No. 3, p 88-89, March, 1984. 1 Fig, 1 Tab.

Descriptors: *Sediment control, *Nonstructural alternatives, *Vegetation, *Roads, Drainage basins, Salt, Sand, Cattails.

Approximately 500 cattail tubers were planted on 6 to 12 inch centers in the bottom of a discharge channel which directs water from a road to a small pond. A chicken wire fence covering was placed over the tubers and staked in place. A basin area about 9 x 9 x 2 ft deep was shaped and lined with large flat stones directly below the road discharge culvert outlet and up gradient of the planted discharge channel to act as a velocity dissipator and primary sediment trap. About 0.4 mile of state highway drains to the control area. Based on 25 storms per season, about 7.8 cubic yards of sand are applied to the area from the state highway. Results of the study show that plants can provide satisfactory sediment control. Projected maintenance costs for catch basin cleaning, including a rented vacuum truck and two men, approximates $55 per catch basin per year. (Baker-IVI)
W84-03987

HYDROLOGIC ENGINEERING CENTER EXPERIENCE IN NONSTRUCTURAL PLANNING,
Hydrologic Engineering Center, Davis, CA.
W. K. Johnson, and D. W. Davis.
Water Resources Bulletin, Vol. 20, No. 1, p 15-21, February, 1984. 2 Fig, 15 Ref.

Descriptors: *Nonstructural alternatives, *Flood plain management, Flood control, Planning, Flood damage.

The Hydrologic Engineering Center, Corps of Engineers, has been engaged in research, training, and project assistance in nonstructural flood control planning for Corps offices across the United States since 1975. Lessons learned from this experience deal with the role of nonstructural measures in flood plain management, the role of creativity in analysis, the role of analysis, and tools for analysis. The role of nonstructural measures in flood control planning depends upon the scale of the problem, the nature of the measure, the degree of protection desired, and whether damage is to existing or future property. An earnest seeking for nonstructural opportunities, a field presence for their formulation, and compatability with local infrastructure plans are prerequisite to creative use of nonstructural measures. Analysis is a necessary complement of creativity. Several tools for nonstructural analysis have been developed and applied to flood problems involving several hundred and several thousand structures. (Author's abstract)
W84-04099

OPERATION OF A TWO-WELL SYSTEM FOR THE CASES OF COMPETITION AND COOPERATION (EXPLOITATION D'UN SYSTEME DE DEUX PUITS EN SITUATION DE COMPETITION ET EN SITUATION DE COORDINATION),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 6B.
W84-04161

6G. Ecologic Impact Of Water Development

HYDROLOGIC-INFORMATION NEEDS FOR OIL-SHALE DEVELOPMENT, NORTHWESTERN COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-03608

SALMON RIVERS COOPERATIVE CONSERVATION ADVISORY COUNCIL STREAM STUDY,
State Univ. of New York Coll. at Oswego.
G. Haggerty.
Report, Temporary State Commission on Tug Hill, Watertown, N.Y., December, 1977. 73 p, 14 Fig, 16 Tab, 18 Ref, 3 Append.

Descriptors: *Streams, *Stream classification, *Regional planning, *Chemical analysis, *Water quality, Stream discharge, Water temperature, Dissolved oxygen, Biochemical oxygen demand, Carbon dioxide, Suspended solids, Specific conductivity, Nitrogen, Nitrates, Ammonia, Phosphorus, Alkalinity, Acid streams, Acidity, Coliforms, Macroinvertebrates, Land use, Acid rain, Stream pollution.

It was the goal of this study to collect information pertaining to the water quality and physical characteristics of streams in the Salmon Rivers Cooper-

ative planning area in order to provide: (1) base data that would be helpful to ongoing land use planning efforts; (2) a beneficial educational experience for residents; (3) data that could be used by other agencies interested in the stream and stream water characteristics of the Salmon River Planning area. The overall water quality was excellent. Although some affects of population centers on stream quality were evident, they did not seem to indicate critical problems, but did show some potential problems to be monitored. Samples were obtained from 13 streams in the towns. Parameters measured included stream flow, temperature, dissolved oxygen, biochemical oxygen demand, carbon dioxide, pH, alkalinity, phosphorus, ammonia, nitrogen-nitrate, suspended solids, specific conductance, and total coliform bacteria. Macroinvertebrate samples from the same locations were obtained. Some of the streams should be considered for reclassification. Population centers could have some affect on the streams and should be tested. Monitoring is recommended for (1) the effect of the salmonid hatchery at Altmer on stream quality and (2) the effect of land use on stream quality above the hatchery. Low alkalinity of the streams may increase the effect of acid rains and should be monitored. (Fazio-Omniplan)
W84-03653

HYDROLOGY REPORT FOR THE SALMON RIVERS COOPERATIVE PLANNING BOARD AREA,
New York State Temporary Commission on Tug Hill, Watertown.
For primary bibliographic entry see Field 2A
W84-03657

TUG HILL REGION: PREPARING FOR THE FUTURE.
Report, Temporary State Commission on Tug Hill, NY., February, 1976. 60 p, 3 Fig, 103 Ref, 2 Append.

Descriptors: *Land use, *Regional planning, *Economic development, *Watershed management, *Forest management, *Water quality management, Urbanization, Acid rain, Acidity, Agriculture, Forests, Recreation, Wildlife, Stream classification, Streams, Water quality standards, Wetlands, Fish, Wind, Flood control, Standards, Regulations, River regulations.

The Temporary State Commission on Tug Hill was formed by the New York State Legislature at the request of local citizens who became concerned when an out-of-state developer obtained an option to buy a very large plot of Tug Hill property. The Commission was charged with studying all factors affecting quality of life and with making recommendations on the future. The Commission found that the social and physical environment of Tug Hill is coming under increasing pressure. Acid precipitation appears to be threatening forest resources, agricultural land, and the region's fishery. The economy is fragile. The most signficant factor that portends an unwanted future for Tug Hill residents is growing urban pressure on the land itself. Left unchecked, land use pressures will lead to speculation, subdivision of parcels, and development for recreational and suburban use. The Commission predicts that over the next 20 years, in the absence of corrective measures, most Tug Hill core lands will be owned by non-residents. The report presents 56 recommendations in eight categories: keep Tug Hill the way it is; maintain a healthy economy; maintain the present high quality of Tug Hill air; protect its watershed and unique areas for enjoyment and utilization; maintain agriculture as a way of life and as a mainstay of the economy; maintain the forests for timber, wildlife, and recreation; maintain Tug Hill's recreational values while providing economic benefits for current residents; preserve home rule and curb the growing cost of government. (Fazio-Omniplan)
W84-03660

SURFACE WATER QUALITY MANAGEMENT PLANNING,
Disko (M.) Associates, Union, NJ.
M. Disko.
Report, July, 1978. 385 p, 39 Fig, 62 Tab.

Descriptors: *Surface water, *Surface-groundwater relations, *Population growth, *Stream discharge, *Streamflow, Streamflow forecasting, Streams, Wastewater disposal, Solid wastes, Catchment areas, Stream profiles, Groundwater quality.

Overall, Ocean County, New Jersey has good to excellent water quality. Some problem areas do exist, however, which are generally related to specific types of land development and use. Clean-up of these few waterways can be successful, but will require the development of appropriate land use practices in the context of an overall water quality management plan. Among the items covered are streamflow measurement and gaging, an inventory of cooling water and wastewater discharge and water withdrawals in the project area, the effects of solid waste landfills on surface water quality, the effects of subsurface sanitary wastewater disposal on surface water quality, and an inventory of land use characteristics upstream from water quality monitoring stations. To prevent groundwater contamination problems from developing in the area, the introduction of a systematic plan to close inferior landfill sites and develop regional facilitates with the proper environmental controls is recommended. There are 28 major mainland drainage basins within the county. The population is growing at a higher rate than any other county in the state, which is putting pressure on resources. Baseline data, stored in the state's STORET computer, were from geographical, climatological, hydraulic, and water quality sources. Of the 21 parameters measured, time permitted evaluation of only five for this report. (Garrison-Omniplan)
W84-03677

TUG HILL RESOURCE MANAGEMENT PLAN.
Cooperative Tug Hill Planning Board, Loraine, NY.
Report, 1976. 82 p, 14 Fig, 15 Ref, 7 Append.

Descriptors: *Resources management, *Regional planning, *Land use, *Natural resources, Social needs, Human population, Agriculture, Forests, Transportation, Recreation, Streams, Economic aspects, Soil types, Slopes, Wetlands, Climatic data.

In June 1974 the Town of Redfield, New York, invited neighboring towns to meet and discuss working together to plan the future direction of land use for central Tug Hill. The Cooperative Tug Hill Planning Board held its first official meeting October 7, 1974. The nine participating towns shared the central Tug Hill forest and watersheds. The Plan which this document presents is based on an inventory of natural resources and a review of man's current impact on the land. For each of the towns, the planners gathered data on soil, slopes, water resources, forest classification and wildlife habitats, and climate. Maps depict the results of the inventories. In what has been called 'the core' lies one of the largest uninterrupted tracts of forest in New York State. The future water supply resource of the region is directly related to forest land use. Ten river systems have their headwaters in the core area. The plan components included social and economic considerations. Goals and objective with respect to major land use categories reflect the needs and aspirations of the residents as measured by questionnaire and a series of local meetings. The plan section of the document identifies future land use patterns proposed for Tug Hill. Some of the ways in which the towns may seek to implement the plan are described. (Fazio-Omniplan)
W84-03694

EFFECT OF AN IMPOUNDMENT ON THE UPSTREAM AND DOWNSTREAM FISH TAXOCENES (SPEED RIVER, ONTARIO, CANADA),
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak, R. Mahon, and E. K. Balon.
Archiv fur Hydrobiologie, Vol. 99, No. 2, p 200-207, January, 1984. 4 Tab, 16 Ref.

Descriptors: *Fish populations, *Dam effects, *Environmental effects, *Speed River, *Ontario, Species diversity, Turbidity, Density, Guelph Reservoir, Reservoir releases.

Changes were noted in fish taxocenes at two localities, one upstream and the other downstream, after damming of the Speed River had been completed. The collection locations were about 5 km upstream and 1 km downstream of the Guelph Reservoir on the upper Speed River watershed. Upstream species composition changed only slightly, but the total population biomass increased 3.5 times, probably as a result of an increase in density rather than as a result of increased growth rates. Downstream new species were found and four previously dominant species were absent, probably due to the cold hypolimnial water released from the reservoir. Disturbances or declines in reproduction of several species were noted. In spite of this the production increased 3.2 times. As two years and 8 months have elapsed since the dam was finished, it appears that repopulation of the sections has been completed. (Baker-IVI)
W84-03747

SOME ENVIRONMENTAL ASPECTS OF PROPOSED HYDROELECTRIC SCHEMES ON THE ZAMBEZI RIVER, ZIMBABWE,
Zimbabwe Univ., Mount Pleasant. Dept. of Biological Sciences.
R. F. Du Toit.
Biological Conservation, Vol. 28, No. 1, p 73-87, 1984. 3 Fig, 12 Ref.

Descriptors: *Hydroelectric plants, *Environmental effects, *Dam effects, *Zambezi River, *Zimbabwe, Wildlife, Wilderness areas.

Preliminary environmental impact studies of proposed additional hydroelectric schemes to meet the growing electricity demand of Zimbabwe have shown that one particular scheme poses a serious threat. This scheme, at Mupata Gorge, threatens the wilderness character and wildlife resources of the middle Zambezi valley. The Mupata scheme would flood a portion of the Zambezi Valley below Lake Kariba. An alternative scheme, located at Batoka Gorge, would entail much less environmental cost. The dam in Batoka Gorge would be sited about 50 km downstream of the Victoria Falls, and would be nearly 200 m high. The lake would be less than 1 km wide along most of its length. Likely impacts of these schemes on mammals, birds, fish, terrestrial and aquatic vegetation, human health and other environmental aspects are considered. Further environmental research is recommended before a final decision can be made. (Baker-IVI)
W84-03860

CHATTANOOGA SHALE EXPLOITATION AND THE AQUATIC ENVIRONMENT: THE CRITICAL ISSUES,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. K. Eddlemon, and V. R. Tolbert.
Environment International, Vol. 9, No. 2, p 85-95, 1983. 4 Fig, 3 Tab, 59 Ref. Department of Energy contract W-7405-eng-26.

Descriptors: *Oil shale, *Aquatic environments, Environmental effects, Environmental impact statement, Erosion, Sedimentation, Acid mine drainage, Leachates, Solid waste disposal, Tennessee, Kentucky, Alabama.

Early identification of the critical environmental issues arising from new energy technologies is needed to ensure adequate consideration of these issues in all phases of research and development. This study examines the potential hazards to aquatic ecosystems from large-scale exploitation (190,000 Mg/day) of the Chattanooga Shale Formation, an immense reserve of oil shale and uranium in Kentucky, Tennessee, and Alabama. Using existing data on regional ecology, hydrology, mining operations, and raw and spent shale chemistry, we identified two major, related environmental issues: (1) the potential for extensive adverse

ffects on aquatic communities through degradaion of water quality and habitat; and (2) the potenial conflict between the requirements for shale xploitation, and the habitat and water quality eeds of threatened or endangered species. Specific azards to aquatic ecosystems include erosion, edimentation, acid mine drainage, raw and spent hale leachates, and surface disposal of immense uantities of solid wastes. Twelve of 19 federally esignated, threatened or endangered fish and molusks in the shale-bearing region were identified as nown or recent inhabitants of the counties beeved to be most favorable for the exploitation of hale. Of these, five species occur as single populaions or are limited to a single river system. The otential for adverse effects on these species is reatest in the counties near the Tennessee-Alaama state line. Future research needs include hysical, chemical, and toxicological characterizaions of shale leachates and studies of the transport nd fate of leachable contaminants. Such research an provide the guidance necessary to minimize mpacts on aquatic communities resulting from exraction, retorting, and disposal of shale. (Author's bstract)
W84-03887

ASSESSMENT OF RIVER CHANNELIZATION N ENGLAND AND WALES,
Southampton Univ. (England). Dept. of Geograhy.
A. Brookes, K. J. Gregory, and F. H. Dawson.
The Science of the Total Environment, Vol. 27, No. 2/3, p 97-111, 1983. 2 Fig, 4 Tab, 56 Ref.

Descriptors: *Channelization, *Environmental effects, *England, *Wales, Rivers, Flood control, Drainage, Navigation, Channel erosion.

The effects of river channelization were surveyed n the United Kingdom by reviewing data collected from annual reports at various water authorities. Far fewer studies on the effects of channelization have been performed in England and Wales than is rue for the North American rivers. River channelzation in England and Wales was undertaken for he purpose of reduction or alleviation of flooding, drainage of agricultural land, benefit of navigation, or reduction or prevention of erosion. Although channel modification has occurred for several centuries, it is only since about 1930 after the Report of the Royal Commission on Land Drainage in England and Wales that a period of intense activity nvolving substantial lengths of river occurred. It is suggested that surveys of the extent and character of channelization are needed to aid is assessing the magnitude of channelization effects and to consider he relative merits of alternative channelization strategies. (Baker-IVI)
W84-03992

EFFECTS OF DREDGING ON ADJACENT WATERS,
Tulane Univ., New Orleans, LA.
C. Grimwood.
Journal of Environmental Engineering, Vol. 109, No. 1, p 47-65, February, 1983. 16 Fig, 15 Ref.

Descriptors: *Dredging, *Ocean dumping, *Environmental effects, *New Orleans, *Louisiana, *Mississippi river, Fate of pollutants, Sediments, Dilution, Waste disposal.

Large volumes of material are dredged each year during the development and maintenance of waterways and harbors. An intensive monitoring program was conducted prior to, during, and after dredging operation in the Mississippi River and other waterways in the New Orleans District of the Army Corps of Engineers. The concentration of pollutants found in the bottom sediment material to be excavated are several orders of magnitude higher than those present in the dredge effluent and are not good indicators of the potential release of these constituents into the water column. The standard elutriate is generally a good simulator of the dredge effluent. In the Mississippi River at New Orleans, the effect of discharging dredge effluent from the pipeline of a cutterhead dredge on the concentration of constituents is short-lived and usually completely disappears at distances greater than 60 ft (18.3 m) downstream from the discharge pipe. The material released from a hopper dredge during ocean dumping operations settles at a rapid rate, and the diffusion and dispersion of the constituents of interest is negligible and confined to the boundaries of the release zone. Even though large volumes of botton material are resuspended during agitation dredging, the effects of this material on channel waters are transient, and normal conditions are restored within a short period of time. Generally, the material dredged during these investigations did not present a hazardous waste disposal problem, as dilution was rapid and increased concentrations of pollutants were confined to the disposal area or mixing zone. (Moore-IVI)
W84-04044

SUITABILITY ANALYSIS FOR SELECTION OF PIPELINE ROUTES,
Louisiana State Univ., Baton Rouge. Dept. of Petroleum Engineering.
C. A. Whitehurst, and R. A. Kinney.
Water Resources Bulletin, Vol. 20, No. 1, p 1-8, February, 1984. 6 Fig, 5 Tab, 13 Ref.

Descriptors: *Environmental effects, *Pipelines, *Louisiana, *Suitability analysis, Construction, Site selection, Drainage, Water quality.

A brief review of environmental assessment methods is presented as an introduction to a study of environmental management problems in a coastal area of southern Louisiana. The assessment method used in the study is called suitability analysis and involves the use of matrices. The matrix approach is simply a convenient method for organizing all factors representing environmental concerns in a region. The matrices proved to be very useful in defining the present state of an environmental regime and in maintaining an inventory of regional features and potential impacts. The method is described in detail and illustrated by evaluating the potential impacts of a major pipeline construction job in the area. Of major concern is the potential impact on the water resources of the region. Disruption to the natural drainage could be detremental, and affect the suitability of available water for a given use. Limitations of the method are discussed and potential areas for improvements and research are noted. Coupled with an economic assessment, the suitability analysis method should prove beneficial for selecting development sites for industries, residential areas, and other construction activities. (Author's abstract)
W84-04097

7. RESOURCES DATA

7A. Network Design

PRELIMINARY SEDIMENT NETWORK EVALUATION FOR THE PICEANCE BASIN, NORTHWESTERN COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Kircher, and P. Guerard.
USGS Water-Resources Investigations Report 82-4046, 1982. 25 p, 11 Fig, 8 Tab, 13 Ref.

Descriptors: *Sediment discharge, Statistical analysis, Regional analysis, Mathematical studies, *Network design, Piceance Creek, Yellow Creek, *Colorado.

Statistical relationships were developed between suspended-sediment discharge and several regional factors of climate, physiography, and land use in the Piceance basin, northwestern Colorado. The purpose of the study was to evaluate the existing sediment collection network, especially in regard to detecting changes in suspended-sediment discharge due to the development in the basin. Spatial- and time variability were examined using multiple linear regression techniques. Because of the short period of record, monthly mean sediment loads were used to determine shifts or changes in trends due to mining and related activities in the basin. Dummy variable analysis was used to detect these premining and postmining differences in the regression lines and also to detect seasonal differences in the sediment discharge. Differences did exist in the sediment discharge from season to season and before and after mining; however, due to the variability and short period of record the cause of these differences could not be adequately determined. Part of the high variability in sediment discharge was due to variability in the water discharge. Therefore, if the network is to be improved, the emphasis needs to be on improvement of the water-discharge. The results of the monthly mean regression analysis were used in the mean monthly and mean annual analysis for determination of initial network design equations. These were only preliminary in nature and could be improved with additional data. (USGS)
W84-03585

HYDROLOGIC-INFORMATION NEEDS FOR OIL-SHALE DEVELOPMENT, NORTHWESTERN COLORADO.
Geological Survey, Lakewood, CO. Water Resources Div.
USGS Water-Resources Investigations Report 82-4076, 1982. 92 p, 30 Fig, 5 Tab, 69 Ref. Compiled by Taylor, O. J.

Descriptors: *Oil shale, Drilling, *Aquifer testing, Mine drainage, *Groundwater availability, Water quality, Benthic fauna, Suspended sediments, Surface runoff, Springs, Acid rain, Spoil disposal, Waste disposal, *Colorado, Piceance basin.

Hydrologic information is not adequate for proper development of the large oil-shale reserves of Piceance basin in northwestern Colorado. Exploratory drilling and aquifer testing are needed to define the hydrologic system, to provide wells for aquifer testing, to design mine-drainage techniques, and to explore for additional water supplies. Sampling networks are needed to supply hydrologic data on the quantity and quality of surface water, ground water, and springs. A detailed sampling network is proposed for the White River basin because of expected impacts related to water supplies and waste disposal. Emissions from oil-shale retorts to the atmosphere need additional study because of possible resulting corrosion problems and the destruction of fisheries. Studies of the leachate materials and the stability of disposed retorted shale piles are needed to insure that these materials will not cause problems. Hazards related to in-situ retorts, and the wastes related to oil-shale development in general also need further investigation. (USGS)
W84-03608

COMPARISON OF MULTIPLATE AND SURBER SAMPLERS IN A COLORADO MOUNTAIN STREAM,
Chadwick and Associates, Littleton, CO.
J. W. Chadwick, and S. P. Canton.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 287-292, December, 1983. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Mountain streams, *Sampling, *Colorado, *Invertebrates, Substrates, Rocky Mountains, Surber samplers, Multiplate samplers, Seasonal variations, Streams.

Comparisons of Surber sampling of natural substrates and multiplate artificial substrates for invertebrates were made in Trout Creek, a mountain stream in northwest Colorado. Over the year long study, multiplate samplers produced generally similar trends in benthic density, biomass and number of species when compared to Surbers, although values for multiplates were usually lower. Seasonal patterns exhibited basically opposite trends at all stations. Coefficient of variability calculations showed that the multiplates gave significantly lower variability than Surbers only for biomass, but not for density and number of species. The lack of the expected consistently reduced variabiliy on the plates may be due to the proximity of the samples to the substrate. In this study multiplate samplers provided little additional information compared to Surber sampling of natural substrates and did not significantly reduce sample variability. Yet the plates still required extra field

time for placement, colonization, and retrieval. Because of this, multiplate samplers do not appear to offer any distinct advantages over Surber sampling of natural substrates in Rocky Mountain streams. (Baker-IVI)
W84-03958

STATUS OF IRRIGATION AND DRAINAGE RESEARCH IN THE UNITED STATES.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 55-74, March, 1984. 4 Tab, 13 Ref.

Descriptors: *Irrigation, *Drainage, *Research priorities, Irrigation management, Water use, Soil salinity, Water quality, Soil conservation, Water conservation.

High priority research objectives for irrigation and drainage in the United States are identified. These include: (1) development of more efficient irrigation distribution and on-farm systems and management practices to increase water use efficiency, control soil salinity, and reduce degradation of downstream water quality; (2) development of improved and new technology to conserve and manage soil and water resources to enhance soil productivity and improve production efficiency; (3) development of improved systems and practices to store and deliver water supplies to farms as needed for efficient crop production; and (4) development of more efficient drainage systems and practices to control soil water for crop production in humid regions. Current national and regional research programs are described. (Author's abstract)
W84-04094

7B. Data Acquisition

ELECTROCHEMICAL INSTRUMENTATION SYSTEM FOR OPTIMIZING IRRIGATION SCHEDULES, PHASE III,
Arizona Univ., Tucson.
W. G. Gensler.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84-154392, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, January, 1984. 17 p, 10 Fig, 6 Ref. Project No. OWRT A-110-ARIZ (1), Contract/Grant No. 14-34-0001-1103.

Descriptors: *Electrochemistry, Polentrometric level, Electrodes, Irrigation water, Plant growth, *Instrumentation, Irrigation schedules, Optimization, Telemetry, *Remote sensing.

The emphasis in this phase of the project was threefold: 1. to develop an agronomic standard for calibration of the electrochemical sensors, 2. to design and construct a prototype agricultural telemetry system and assess its economic feasibility, 3. to determine the fundamental electrochemical origin of the electropotentials. An agronomic standard has been developed based on the use of stem diameter measurements. Part of a prototype agricultural telemetry system has been constructed and tested. Cyclic voltammetry was implemented to determine the electrochemical origin of the electro-potential and further work in multi step, twin cell coulometry is well under way.
W84-03667

MODELLING DAILY EVAPOTRANSPIRATION USING REMOTELY SENSED DATA,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
R. J. Gurney, and P. J. Camillo.
Journal of Hydrology, Vol. 69, No. 1-4, p 305-324, February, 1984. 6 Fig, 6 Tab, 13 Ref. Goddard Space Flight Center contract NAS5-24350.

Descriptors: *Model studies, *Evapotranspiration, *Remote sensing, Mathematical models, Soil water, Temperature, Wheat, Barley, Eddies, Hannover, Federal Republic of Germany.

Evaporation and soil-moisture status are important hydrological parameters which are difficult to estimate conventionally over large areas. There are some indications that remotely-sensed measurements may be able to assist in their estimation for these large areas. An energy-balance model is used to estimate daily evapotranspiration for 3 days for a barley field and a wheat field near Hannover, Federal Republic of Germany. The model was calibrated using once-daily estimates of surface temperatures, which may be remotely sensed. The evaporation estimates were within the 95% error bounds of independent eddy correlation estimates for the daytime periods for all 3 days for both sites, but the energy balance, estimates are generally higher; it is unclear which estimate is biassed. Soil moisture in the top 2 cm of soil, which may be remotely sensed, may be used to improve these evaporation estimates under partial ground cover. (Murphy-IVI)
W84-03790

BARE-SOIL EVAPORATION DETERMINED IN SITU BY INFRARED THERMOMETRY,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
For primary bibliographic entry see Field 2D.
W84-03791

MODERN TOOLS CUT THE COST OF WATER EXPLORATION AND EVALUATION,
Atlas Copco A.B., Stockholm (Sweden).
B. Tornqvist.
The Johnson Driller's Journal, Vol. 55, No. 2, p 4-7, 1983. 2 Fig.

Descriptors: *Measuring instruments, *Well logs, *Remote sensing, *Water resources development, *Exploration, Groundwater, Aquifer characteristics.

A complete program for evaluation of groundwater reaources in areas where little work has been undertaken starts with a general reconnaissance study followed by more detailed surveys in selected areas. The third stage is test drilling, pumping and water balance calculations. The results of these guide the final development phases. The wide variety of scientific and technical tools developed and used in recent years in the search for and the evaluation of groundwater resources are reviewed. The tools range from satellite photography of the ground surface to well logging below the surface. Techniques discussed include infrared sensitive film mapping, magnetic survey methods, electrical method to provide indirect evidence of subsurface aquifers, resistivity measurements, tracing of electric current at the surface, use of information from seismic waves, and types of geophysical logging. (Baker-IVI)
W84-03951

CORRECTION OF MEASURED PRECIPITATION IN THE ALPS USING THE WATER EQUIVALENT OF NEW SNOW,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2C.
W84-03976

PORTABLE, COMPUTERIZED MONITOR KEEPS TABS ON WATER,
Michigan Univ., Ann Arbor. School of Public Health.
R. A. Deininger.
Water Engineering and Management, Vol. 131, No. 2, p 32-33, 53, February, 1984. 3 Fig, 3 Tab.

Descriptors: *Monitoring, *Water quality control, Computers, Measuring instruments, Data processing, Data acquisition.

Recent events of the microcomputer age have made available inexpensive and mobile computing power, which significantly extends the data-logging and analysis capabilities of water quality monitors. A system is described which will monitor the water quality at a given location continuously over time, record all data collected in machine-readable form, transmit the data once collected to a central computing system, and be mobile enough that it could be taken to any location at a river and also on a boat. The microcomputer is an APPLE II with 48 K bytes of memory and a single floppy disk drive. Operating the system is quite simple and several programs have been written in BASIC, which allow the storage and retrieval of the data. Two programs are shown - the water quality monitoring program and the one which retrieves the data from the disk. The system has been succussfully used at a fixed location and from a boat. (Baker-IVI)
W84-04004

EXPERIMENTAL STUDIES IN NATURAL GROUNDWATER RECHARGE DYNAMICS: ASSESSMENT OF RECENT ADVANCES IN INSTRUMENTATION,
Kansas State Geological Survey, Lawrence.
M. Sophocleous, and C. A. Perry.
Journal of Hydrology, Vol. 70, No. 1-4, p 369-382, 1984. 9 Fig, 6 Ref.

Descriptors: *Instrumentation, *Sensors, *Monitoring, *Groundwater recharge, Logging (recording), Data collection, Meteorological data collection, Automation.

Two sites in southcentral Kansas were instrumented with various modern sensors and data microloggers. Data from the sensors were collected using microloggers in combination with magnetic-cassette tape, graphical and digital recorders, analog paper-tape recorders, and direct observations to evaluate and automate data collection and processing. Atmospheric sensors included an anemometer, a tipping-bucket raingage, an air temperature thermistor, a relative-humidity probe, a net radiometer, and a barometric-pressure transducer. Sensors in the unsaturated zone consisted of soil-temperature thermocouples, tensiometers coupled with pressure transducers and dial gages, gypsum blocks, and a neutron moisture probe operated by an observer. The saturated-zone sensors consisted of a water-level pressure transducer, a conventional float gage connected to a variable potentiometer, soil thermocouples, and a number of multiple-depth piezometers. Certain types of equipment such as pressure transducers are very sensitive to environmental conditions. Extraordinary steps had to be taken to protect some of the equipment whereas other equipment seemed to be reliable under all conditions. In order to enhance the reliability of the system and to minimize data losses sensors and data loggers should be purchased from reputable firms, and back-up systems should be arranged. Shock and polarity protection is essential for electronic equipment. The unit housing the data loggers and all electric connections must be insulated against moisture and temperature fluctuations. (Moore-IVI)
W84-04162

NEW AMPOULE TYPE WATER SAMPLER FOR MICROBIOLOGICAL STUDY IN AQUATIC ENVIRONMENTS,
Nagoya Univ. (Japan).
H. Terai, and Y. Saijo.
Japanese Journal of Limnology, Vol. 44, No. 4, p 341-344, October, 1983. 3 Fig, 12 Ref.

Descriptors: *Sampling, *Biological samples, Aquatic environment, Lakes, Limnology.

An aseptic water sampler has been devised for making microbiological investigations more effective in aquatic environments. The sampler uses glass ampoules as sampling vessels. The new sampler resembles Sorokin's sampler as it employs the same use of evacuated glass ampoules for sampling vessels and the device of serial sampling, but has a stainless-steel cylinder in which three ampoules are inserted with only one cylindrical messenger to snap off the glass capillary. The new device has been used for studies on Lake Kizaki since 1976. (Baker-IVI)
W84-04171

7C. Evaluation, Processing and Publication

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-8 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03555

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN NORTHEASTERN AND WESTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03556

DRAINAGE DIVIDES, MASSACHUSETTS--BLACKSTONE AND THAMES RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
B. E. Krejmas.
USGS Open-File Report 82-631, 1982. 12 sheet maps, 1 Fig.

Descriptors: *Blackstone River, French River, Quinebaug River, eastern Hampden County, eastern Hampshire County, southern Middlesex County, southern Worcester County, western Norfolk County, *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps.

Drainage boundaries for selected subbasins of the Blackstone and Thames River basins in eastern Hampden, eastern Hampshire, western Norfolk, southern Middlesex, and southern Worcester Counties, Massachusetts, are delineated on 12 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 miles on tributary streams or 15 square miles along the Blackstone River, French River, or Quinebaug River. (USGS)
W84-03558

GEOLOGIC AND WELL-CONSTRUCTION DATA FOR THE H-9 BOREHOLE COMPLEX NEAR THE PROPOSED WASTE ISOLATION PILOT PLANT SITE, SOUTHEASTERN NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03561

WATER LEVELS IN NASSAU COUNTY SEWER DISTRICTS 2 AND 3, LONG ISLAND, NEW YORK, 1978-1979,
Geological Survey, Syosset, NY. Water Resources Div.
H. F. H. Ku, and D. L. Simmons.
USGS Water-Resources Investigations Report 82-4017, 1983. 30 p, 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Water-level fluctuations, Wells, Groundwater, Base flow, Glacial aquifers, *New York, Long Island, Nassau County.

Prior to development on Long Island, about 95 percent of total streamflow originated as groundwater seepage from the upper glacial aquifer; the remaining 5 percent consisted of direct storm runoff. Thus, the streams on Long Island function as groundwater drains. Their flow in dry weather is directly controlled by groundwater levels adjacent to the stream channels. Sewage systems in Nassau County have caused a general lowering of groundwater levels, which in turn has severely reduced streamflow. This report presents monthly water-level measurements in 259 wells in Nassau county from 1978-79 to provide a data base to evaluate the need to replace streamflow lost through lowering of the water table. (USGS)
W84-03563

UNCERTAINTIES IN RECORDS OF ANNUAL MEAN DISCHARGE IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine.
USGS Water-Resources Investigations Report 83-4025, April, 1983. 108 p, 3 Fig, 55 Tab, 5 Ref.

Descriptors: *Hydrologic data, *Stream discharge, *Stream gages, *Errors, *Maine, Network analysis, Annual mean discharge.

This report documents the results of rating analyses of flow during periods of ice-cover at 33 stations on selected rivers in Maine. Results were obtained through linear multiple regression. It also presents functions relating uncertainties in records to the number of discharge measurements made at these and 21 other stations. The application is unusual in that it includes analysis of the uncertainty of discharge as affected by backwater from ice. Total uncertainty consists of errors incurred during measurement and during data processing. An average of 46.8 percent of the total variance for the 21 stations not affected by backwater was due to measurement variance, and 53.2 percent was due to process variance. Data from the remaining 33 stations were divided into summer (open-water) periods and the winter (backwater) periods. An average of 49.3 percent of the total variance for the summer-period stations was due to measurements variance; 50.7 percent was due to process variance. An average of 25.2 percent of the total variance for the winter-period stations was due to measurement variance; 74.8 percent was due to process variance. Results of the seasonal division of average variance suggest that the process and measurement variances are essentially equal during open-water periods and that process variance is considerably greater than the measurement variance during backwater periods. The errors in winter discharge records significantly increased average uncertainty in the records of annual mean discharge. (USGS)
W84-03564

WATER RESOURCES OF THE TRUK ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
USGS Water-Resources Investigations Report 82-4082, 1983. 223 p, 36 Fig, 81 Tab, 38 Ref.

Descriptors: *Hydrologic data, Weather data, Geology, Water resources development, *Data collection, *Pacific Islands, *Truk Islands.

The Truk Islands, part of the Caroline Islands in the western Pacific, consist of 19 volcanic islands and about 65 coral islets. The volcanic islands and some of the coral islets are scattered in an 820-square-mile lagoon enclosed by a 125-mile long barrier reef. Moen, although not the largest, is by far the most developed island and is the adminstrative, commercial, educational, and transporation center of the islands. Monthly rainfall records for most years are available since 1903. Rainfall-runoff comparisons show that about half the annual rainfall runs off as surface water into Truk Lagoon. Flow characteristics of the major streams, based on more than 11 years of record, are provided and the application of data for possible use in the design of reservoirs and rain catchments is included. Historical and present development of all water sources is given. The chemical analyses of surface and ground water on Moen, with the exception of water from well 9, show the good quality of the water sources. This report summarizes all hydrologic data collected and provides interpretations that can be used for development and management of the water resources. (USGS)
W84-03565

USE OF DIGITAL LAND-COVER DATA FROM THE LANDSAT SATELLITE IN ESTIMATING STREAMFLOW CHARACTERISTICS IN THE CUMBERLAND PLATEAU OF TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03566

WATER RESOURCES OF THE YAP ISLANDS,
Geological Survey, Honolulu, HI. Water Resources Div.
O. Van der Brug.
USGS Water-Resources Investigations Open-File Report 82-357, 1983. 187 p, 3 Fig, 75 Tab, 31 Ref.

Descriptors: *Hydrologic data, Geology, Water resources development, *Data collection, *Pacific Islands, *Yap Islands.

The Yap Islands consist of four major islands, Yap, Gagil-Tomil, Map, and Rumung. Of these, Yap Island has more than half the total land area, most of the population, and almost all of the economic development. The islands of Map and Rumung together compose only 15 percent of the land area and population and are not discussed in this report. This report summarizes the hydrologic data collected and provides interpretations that can be used by the planning and public works officials of Yap to make decisions concerning development and management of their water resources. Included are a summary of streamflow characteristics, based on more than 12 years of record, and a compilation and interpretation of the available ground-water and water-quality information. Monthly rainfall totals for most years since 1900 are tabulated and rainfall-runoff comparisons are made. Available data on evaportation and water and air temperatures are summarized. Application of the data for use in the design of reservoirs and rain catchments is discussed and is augmented by tables and illustrations. (USGS)
W84-03568

YEARLY VARIATIONS IN RUNOFF AND FREQUENCY OF DRY YEARS FOR CONTERMINOUS UNITED STATES, 1911-79,
Geological Survey, Reston, VA. Water Resources Div.
W. B. Langbein, and J. R. Slack.
Available from the Ofss, USGS, Box 25425, Lakewood, CO 80225, Price; $11.25 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-751, 1982. 85 p, 73 Fig, 3 Tab, 5 Ref.

Descriptors: *Streamflow, Drought, *Variability, Spatial distribution, Temporal distribution, *Runoff frequency, United States, Canada, *Data collection, Historical data.

Gaging-station data are presented on variations in annual runoff over the conterminous United States and nearby Canada during the period 1911-79 in tabular and graphic (map) form. These data bring up-to-date and extend backward in time previous reports on streamflow stations by Harbeck and Langbein in 1949 which covered the period 1921-45 and that by Busby in 1963 which covered the period 1931-60. As depicted in Langbein and Slack (1980), these data show that, contained within a rather large seemingly random or sporadic pattern, there appears to be a previously unnoticed degree of similarity in the occurrence of subnormal flows across the country. In each of three regions, viz., West, Center, and East, dry years were concentrated in two sequences, one centered in the 1930's and the second in the decade from the mid-50's to the mid-60's. (USGS)
W84-03569

SIMULATED CHANGES IN WATER LEVEL IN THE MINJUR AQUIFER, RIYADH AREA, SAUDI ARABIA,
Geological Survey, Riyadh (Saudia Arabia). Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03571

NUMERICAL SIMULATION OF THE ALLUVIUM AND TERRACE AQUIFER ALONG THE NORTH CANADIAN RIVER, CANTON LAKE TO LAKE OVERHOLSER, CENTRAL OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03572

JANUARY 1983 WATER LEVELS, AND DATA RELATED TO WATER-LEVEL CHANGES, WESTERN AND SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
M. E. Pabst.
USGS Open-File Report 83-762, 1983. 164 p, 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Groundwater, *Water level changes, *Hydrologic data, *Kansas, Data collection.

Water-level measurements were made, mostly in January 1983, in about 1,540 wells in western and south-central Kansas. The measurements were made in mid-winter when pumping was minimal and water levels had recovered, for the most part, from the effects of pumping during the previous irrigation season. Annual hydrologic data are provided for relating water-level changes from a 'base-reference year' (predevelopment year), a year of abnormally high rainfall and minimum pumpage (1966 or 1974) and each of seen consecutive years of measurement (1977-83). The 'base-reference year' is designated as 1940 for the southwestern area, 1944 for the south-central area, and 1950 for the northwestern and west-central areas. Water levels for the 'base-reference year' are established by measurements made during that year and by interpretation of maps showing water-level altitudes. Data also are provided for relating the average annual water-level changes, saturated thicknesses of the deposits, and percentage changes in saturated thicknesses. (USGS)
W84-03579

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN WYOMING, FISCAL YEARS 1981 AND 1982.
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-03580

DATA SUPPLEMENT TO: QUALITY OF COAL MINE DRAINAGE IN WASHINGTON, 1975-77,
Geological Survey, Tacoma, WA. Water Resources Div.
L. A. Fuste', F. A. Packard, M. O. Fretwell, and D. P. Garland.
USGS Open-File Report 83-205, 1983. 61 p, 10 Fig, 21 Tab, 8 Ref.

Descriptors: Mine wastes, *Mine drainage, *Coal mines, *Water quality, Biological samples, *Chemical analysis, Discharge measurement, Physical properties, *Washington, Coal-bearing areas.

From December 1975 to September 1977 the U.S. Geological Survey studied coal mine drainage in western Washington to 1) characterize the water quality of drainage from abandoned mines in the 11 coal-bearing areas of the State; 2) examine the water quality effects on a stream receiving drainage from an abandoned coal mine; 3) determine the baseline water-quality conditions at two prospective underground coal mine areas; and 4) recommend procedures for monitoring stream quality in the baseline areas in the event that mining occurs. This report presents physical, chemical, and biological data collected during the study period from Gallop Creek (Whatcom County), Loretta Creek (Skagit County), and Wilkeson Creek (Pierce County) and from 100 abandoned coal mines in western Washington, and from a borehole hydraulic-mining test site. Biological information included taxonomic identifications and counts of benthic invertebrates and periphytic algae. (USGS)
W84-03581

WATER QUALITY OF SOMERVILLE LAKE, SOUTH-CENTRAL TEXAS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2H.
W84-03583

WATER QUALITY AND OTHER HYDROLOGIC DATA COLLECTED IN AND AROUND A SURFACE COAL MINE, CLAY AND VIGO COUNTIES, INDIANA, 1977-80,
Geological Survey, Indianapolis, IN. Water Resources Div.
L. L. Bobo, and S. E. Eikenberry.
Available from the Ofss, USGS, Fed. Ctr. Lakewood, CO 80225, Price: $15.75 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-639, October, 1982. 117 p, 5 Fig, 34 Tab, 23 Ref.

Descriptors: *Aquifers, Assessments, *Coal mines, Confined aquifers, Data collections, Dissolved oxygen, Geohydrology, *Groundwater, Heavy metals, *Indiana, Iron, Land use, *Mine drainage, Observation wells, Precipitation, Strip mines, Water level, Watersheds, Active mining, Honey Creek, North Branch Honey Creek, Reclaimed coal-mine land, Stone Quarry Branch, Surface coal-mine land, Unreclaimed surface coal-mine-land.

Few data are available for evaluating water-quality and other hydrologic properties in and around surface coal mines, particularly in areas where material having a high potential for acid-production is selectively buried. This report contains hydrologic data collected in an active coal mining area in Clay and Vigo Counties, Indiana, from September 1977 through February 1980. Methods of sampling and analysis used in collecting the data also are summarized. The data include field and laboratory measurements of water at 41 wells and 24 stream sites. Variables measured in the field include water temperature, specific conductance, pH, Eh, dissolved oxygen, ground-water levels, and streamflow; and in the laboratory, concentrations of major ions, alkalinity, hardness, trace elementsl, organic carbon, phosphorus, and dissolved solids. Other variables measured in the laboratory include ferrous iron concentration of water samples from selected wells, percent sulfur by weight and the potential acidity of core samples of reclaimed cast overburden, concentrations of elements absorbed on streambed materials, concentrations and particle size of suspended sediment in water, and populations and Shannon diversity indices of phytoplankton in water. Dissolved-solids concentrations and pH of ground water ranged from 173 to 5,130 milligrams per liter and from 6.1 to 8.9, respectively, and of surface water, from 120 to 4,100 milligrams per liter and from 6.1 to 8.8 respectively. (USGS)
W84-03597

DRAINAGE DIVIDES, MASSACHUSETTS--HOUSATONIC RIVER BASIN,
Geological Survey, Boston, MA. Water Resources Div.
A. Gadoury, and S. Wandle, Jr.
USGS Open-File Report 82-634, 1982. 12 sheet maps, 14 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, *Housatonic River, Berkshire County.

Drainage boundaries for selected subbasins in Berkshire County, Massachusetts, are delineated on 12 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 15 square miles along the Housatonic River. (USGS)
W84-03598

DRAINAGE DIVIDES, MASSACHUSETTS--DEERFIELD AND MILLERS RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
B. E. Krejmas, and S. W. Wandle, Jr.
USGS Open-File Report 82-632, 1982. 16 sheet maps, 1 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, Deerfield River, Millers River, Franklin County, Worcester County.

Drainage boundaries for selected subbasins in Franklin and northwestern Worcester Counties, Massachusetts, are delineated on 16 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 10 square miles along the Millers and Deerfield Rivers, or 20 square miles along the Connecticut River. (USGS)
W84-03599

DRAINAGE DIVIDES, MASSACHUSETTS--WESTFIELD AND FARMINGTON RIVER BASINS,
Geological Survey, Boston, MA. Water Resources Div.
R. A. Gadoury, and S. Wandle, Jr.
USGS Open-File Report 82-635, 1982. 15 sheet maps, 1 Fig.

Descriptors: *Drainage basins, *Surface waters, *Massachusetts, Sites, Hydrologic data, *Maps, Westfield River, Farmington River, Hampshire County, Hampden County, Berkshire County.

Drainage boundaries for selected subbasins in western Hampshire, western Hampden, and southeastern Berkshire Counties, Massachusetts, are delineated on 15 topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for streams where the drainage area is greater than 3 square miles. Successive sites along watercourses are indicated where the intervening area is at least 6 square miles on tributary streams or 10 square miles along the Westfield or Farmington Rivers. (USGS)
W84-03600

ANALYSES OF ELUTRIATES, NATIVE WATER, AND BOTTOM MATERIAL IN SELECTED RIVERS AND ESTUARIES IN WESTERN OREGON AND WASHINGTON,
Geological Survey, Portland, OR. Water Resources Div.
G. J. Fuhrer, and F. A. Rinella.
USGS Open-File Report 82-922, 1983. 147 p, 20 Fig, 27 Tab, 6 Ref.

Descriptors: *Dredging, Environmental effects, Bottom sediments, Water quality, Coos River, *Oregon, Baker Bay, *Washington, Bonneville, Dam, Columbia River.

Chemical analyses of elutriates, bottom sediment and water samples for selected metals, nutrients and organic compounds including insecticides and herbicides have been made to provide data to determine short-term water quality conditions associated with dredging operations in rivers and estuaries. Between May and December 1980 data were collected as far south as the Coos River in Western Oregon, as far north as Baker Bay in Southwestern Washington and as far inland as Bonneville Dam on the Columbia River. In an elutriation test, bottom material from a dredging site is mixed with native water and the filtrate is analysed. Elutriation test results showed variability in concentrates of dissolved chemicals as follows: in micrograms per liter (micro g/l), manganese ranged from 0 to 10,000, iron from 10 to 4300, zinc from 1 to 90, and phenols from 9 to 420; in

milligrams per liter (mg/l), ammonia as nitrogen ranged from 0.03 to 46 and organic carbon from 0.5 to 45. (USGS)
W84-03601

GROUND WATER IN THE NORTHERN PART OF CLACKAMAS COUNTY, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03602

GROUND-WATER RESOURCES OF THE RUTLAND AREA, VERMONT,
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03609

WATER RESOURCES DATA NEW YORK, WATER YEAR 1982: VOLUME 2. LONG ISLAND,
Geological Survey, Syosset, NY. Water Resources Div.
A. G. Spinello, J. H. Nakao, W. J. Flipse, Jr., and J. G. Carcaci.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 119 536. USGS Water-Data Report NY-82-2, 1983. 312 p, 8 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Groundwater, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Long Island streams.

Water resources data for the 1982 water year from New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water quality of precipitation; and water levels and water quality of ground water wells. This volume contains records for water discharge at 17 gaging stations; water quality at 17 gaging stations, 349 wells, and 3 precipitation stations; and water levels at 117 observation wells. Also included are data for 77 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03610

WATER RESOURCES DATA NEW YORK, WATER YEAR 1982: VOLUME 3. WESTERN NEW YORK,
Geological Survey, Ithaca, NY. Water Resources Div.
J. B. Hood, W. H. Johnston, H. J. Zajd, Jr., and H. L. Dixson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 119 544. USGS Water Data Report NY-82-3, 1983. 208 p, 5 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water analysis, Water temperature, Water levels, Water wells, *Data collections, Sites, Susquehanna River basin, Ohio River basin, St. Lawrence River basin.

Water resources data for the 1983 water year for New York consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 88 gaging stations; stage only at 14 gaging stations; stage and contents at 6 gaging stations and 2 other lakes and reservoirs; water quality at 19 observation wells. Also included are data for 59 crest-stage and 2 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. (USGS)
W84-03611

SEDIMENT DATA FOR MID-ARKANSAS AND UPPER-RED RIVER BASINS THROUGH 1980,
Geological Survey, Oklahoma City, OK. Water Resources Div.
S. P. Blumer.
USGS Open-File Report 83-692, 1983. 799 p, 4 Fig, 2 Tab.

Descriptors: *Fluvial sediment, *Suspended sediment concentration, *Water quality, *Sediment data, *Data collection, *Oklahoma, *Kansas, Red River, Arkansas River.

Sediment data have been collected at 279 locations within the Mid-Arkansas and Upper-Red basins in and along the borders of Oklahoma and Kansas. This compilation of sediment records presents tables and plots of all suspended-sediment data collected between 1930 and 1980. The publication not only provides a published source of all available suspended-sediment data, but more importantly provides potential users with an efficient means to access this large amount of data through the U.S. Geological Survey WATSTORE system. (USGS)
W84-03612

WATER RESOURCES DATA OREGON, WATER YEAR 1981: VOLUME 1. EASTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
USGS Water-Data Report OR-81-1, 1983. 242 p, 5 Fig, 1 Tab.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water Resources Data for the 1981 water year for Oregon consists of records of stage, discharge, and water quality of stream; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 270 gaging stations; stage only records for 12 gaging stations; stage and contents for 44 lakes and reservoirs; water quality for 90 gaging stations, water levels for 66 observation wells; and water quality for 8 precipitation stations. Also included are 50 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03613

WATER RESOURCES DATA OREGON, WATER YEAR 1981: VOLUME 2. WESTERN OREGON.
Geological Survey, Portland, OR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 492. USGS Water-Data Report OR-81-2, 1983. 509 p, 5 Fig, 1 Tab.

Descriptors: *Oregon, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water Resources Data for the 1981 water year for Oregon consist of records of stage, discharge, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report, in two volumes, contains discharge records for 270 gaging stations; stage only records for 12 gaging stations; stage and contents for 44 lakes and reservoirs; water quality for 90 gaging stations, water levels for 66 observation wells; and water quality for 8 precipitation stations. Also included are 50 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03614

WATER RESOURCES DATA HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1982: VOLUME 1. HAWAII,
Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 122951. USGS Water-Data Report HI-82-1, 1983. 243 p, 14 Fig.

Descriptors: *Hawaii, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Hawaii and other Pacific Areas consist of records of stage, discharge, and water quality of streams and springs; and water levels and water quality in wells. This report, Volume 1, contains discharge records for 106 gaging stations; water quality for 11 gaging stations, 95 partial-record flow stations, and 152 wells; and water levels for 21 observations wells. Also included are 108 crest-stage partial-record stations and 15 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, Federal, and other agencies in Hawaii. (USGS)
W84-03615

WATER RESOURCES DATA HAWAII AND OTHER PACIFIC AREAS, WATER YEAR 1982: VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU, AND AMERICAN SAMOA,
Geological Survey, Honolulu, HI. Water Resources Div.
S. S. Chinn, G. A. Tateishi, and J. J. S. Yee.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 122 944. USGS Water-Data Report HI-82-2, 1983. 146 p, 16 Fig.

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collection.

Volume 2 of water resources data for the 1982 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams and springs; stage of a lake and a reservoir; and water levels and water quality in wells. This report contains discharge records for 43 gaging stations; stage only records for 2 gaging stations; water quality for 1 gaging station, 36 partial-record stations; water temperature for 42 gaging stations; and water levels for 14 observation wells and water quality for 52 ground-water sites. Also included are 43 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the national Water Data System operated by the U.S. Geological Survey and cooperating Governments and Federal agencies in other Pacific areas. (USGS)
W84-03616

WATER RESOURCES DATA NEW YORK, WATER YEAR 1983: VOLUME 1. EASTERN NEW YORK EXCLUDING LONG ISLAND,

Geological Survey, Albany, NY. Water Resources Div.
T. J. Zembrzuski, Jr., P. M. Burke, R. J. Archer, and J. A. Robideau.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 114 198, USGS Water-Data Report NY-82-1, 1983. 267 p, 5 Fig, 1 Tab.

Descriptors: *New York, *Hydrologic data, *Surface waters, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water analysis, Water temperature, Water levels, Water wells, *Data collections, Sites, Hudson River basin, Delaware River basin.

Water resources data for the 1982 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; quality of precipitation; and water levels of ground-water wells. This volume contains records for water discharge at 99 gaging stations; stage only at 5 gaging stations; and stage and contents at 4 gaging stations, and 19 other lakes and reservoirs; water quality at 25 gaging stations, 5 precipitation stations and water levels at 23 observation wells. Locations of these sites are shown on figures 4A and 4B. Also included are data for 51 crest-stage and 9 low-flow partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurement and analyses. (USGS)
W84-03617

WATER RESOURCES DATA NEBRASKA, WATER YEAR 1981.
Geological Survey, Lincoln, NE. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201 335. USGS Water-Data Report NE-81-1, 1982. 471 p, 6 Fig, 3 Tab.

Descriptors: *Nebraska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1981 water year for Nebraska consist of both surface water and ground water. This report contains water-discharge records for 163 streamflow gaging stations, 48 partial-record or miscellaneous streamflow stations, and 4 crest-stage, partial-record streamflow stations; stage and content records for 10 lakes and reservoirs; water-quality records for 55 streamflow stations, 36 ungaged stream-sites, and 154 wells; and water-level records for 59 observation wells. Additional water-discharge data were collected at various sites, not part of the systematic data-collection program, to determine surface-water/ground-water relationships and are published under low-flow investigations. (USGS)
W84-03618

WATER RESOURCES DATA COLORADO, WATER YEAR 1982: VOLUME 1. MISSOURI RIVER BASIN, ARKANSAS RIVER BASIN, AND RIO GRANDE BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. D. Steger.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 128388. USGS Water Data Report CO-82-1, 1983. 403 p, 6 Fig, 5 Tab.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, Water quality, Flow rate, Gaging stations, Lakes, Reservoir, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Missouri River basin, Arkansas River basin, Rio Grande basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record stations, and 50 miscellaneous sites; water levels for 55 observation wells. Nine pertinent stations in bordering States also are included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W84-03619

WATER RESOURCES DATA COLORADO, WATER YEAR 1982: VOLUME 3. DOLORES RIVER BASIN, GREEN RIVER BASIN, AND SAN JUAN RIVER BASIN,
Geological Survey, Lakewood, CO. Water Resources Div.
J. T. Steinheimer, R. C. Ugland, H. E. Burch, and E. A. Wilson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 138. USGS Water Data Report CO-82-3, 1983. 366 p, 6 Fig, 5 Tab.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Dolores River basin, Green River basin, San Juan River basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record low-flow stations, peak-flow information for 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 245 miscellaneous sites; and water levels for 55 observation wells. Nine pertinent stations in bordering States are also included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W84-03620

WATER RESOURCES DATA OHIO, WATER YEAR 1982: VOLUME 1. OHIO RIVER BASIN,
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Stewart, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229278. USGS Water-Data Report OH-82-1, 1983. 386 p, 3 Fig.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections, Ohio River basin.

Water resources data for the 1982 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 21 gaging stations and 92 wells; and water levels at 194 observation wells. Also included are data from 100 crest-stage partial-record stations; 118 low-flow partial-record stations, and 275 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-03621

WATER RESOURCES DATA OHIO, WATER YEAR 1982: VOLUME 2. ST. LAWRENCE RIVER BASIN, STATEWIDE PROJECT DATA,
Geological Survey, Columbus, OH. Water Resources Div.
H. L. Shindel, L. L. Stewart, and J. R. Kolva.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229260. USGS Water-Data Report OH-82-2, 1983. 288 p, 3 Fig.

Descriptors: *Ohio, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperature, Sampling sites, Water levels, Water analyses, Streamflow, Water wells, Benthic fauna, *Data collections, St. Lawrence River basin.

Water resources data for the 1982 water year for Ohio consist of records of stage, discharge, and water quality of streams; stage and contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report in two volumes contains records for water discharge at 135 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 21 gaging stations and 92 wells; and water levels at 194 observation wells. Also included are data from 100 crest-stage partial-record stations; 118 low-flow partial-record stations, and 275 coal hydrology synoptic sites. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-03622

WATER RESOURCES DATA SOUTH DAKOTA, WATER YEAR 1982,
Geological Survey, Huron, SD. Water Resources Div.
E. B. Hoffman, N. F. Leibbrand, D. R. Winter, and J. R. Little.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 117175. USGS Water-Data Report SD-82-1, (1983). 298 p, 7 Fig, 3 Tab.

Descriptors: *South Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for South Dakota consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 110 gaging stations; stage contents for 14 lakes and reservoirs; water quality for 32 gaging stations; and water levels for 8 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03623

WATER RESOURCES DATA NEVADA, WATER YEAR 1982,
Geological Survey, Carson City, NV. Water Resources Div.
H. R. Frisbie, R. J. LaCamera, M. M. Riek, and D. B. Wood.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120385. USGS Water-Data Report NU-82-1, (1983). 366 p, 9 Fig.

Descriptors: *Nevada, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling

sites, Water levels, Water analyses, *Data collection.

Water-resources data published herein for the 1982 water year comprise the following records: water discharge for 120 gaging stations on streams, canals, and drains; discharge data for 40 peak-flow stations and 5 low-flow stations on streams; stage and contents for 21 lakes and reservoirs; water levels for 229 observation wells; and water-quality data for 93 stream, canal, and drain sites, 13 lake and reservoir sites, and 2 wells. Additional water data, collected at various sites that are not part of the systematic data-collection program, are published as miscellaneous measurements. (USGS)
W84-03624

WATER RESOURCES DATA MICHIGAN, WATER YEAR 1982,
Geological Survey, Lansing, MI. Water Resources Div.
J. B. Miller, J. L. Oberg, and T. Sieger, Jr.
Available from the National Technical Information Service, Springfield, VA 22160, as PB83 229500. USGS Water-Data Report MI-82-1, 1983. 487 p, 9 Fig.

Descriptors: *Michigan, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1982 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water temperature of ground water. This report contains discharge records for 169 gaging stations; stage only records for 4 gaging stations; stage and contents for 5 lakes and reservoirs; water quality for 61 continuous-record stations; and water levels for 53 observation wells. Also included are 82 crest-stage partial-record stations and 44 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. (USGS)
W84-03625

WATER RESOURCES DATA MISSISSIPPI, WATER YEAR 1981.
Geological Survey, Jackson, MS. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170746, USGS Water-Data Report MS-81-1, 1982. 410 p, 5 Fig.

Descriptors: *Mississippi, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection.

Water resources data for the 1981 water year for Mississippi consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report contains records of water discharge at 82 gaging stations; stage records for 18 of these gaging stations; stage only at 4 gaging stations; contents for 4 lakes; water quality for 33 gaging stations, and 123 wells; and water levels for 324 observation wells. Also included are peak-discharge data for 91 crest-stage partial-record stations and water quality data for 18 partial-record or miscellaneous sites. Locations of these sites are shown on Figures 3-5. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03626

WATER RESOURCES DATA MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1981.
Geological Survey, Boston, MA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201939. USGS Water-Data Report MA-RI-81-1, 1982. 281 p, 5 Fig, 1 Tab.

Descriptors: *Massachusetts, *Rhode Island, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1981 water year for Massachusetts and Rhode Island consist of records of stage, discharge, and water quality of streams; contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 100 gaging stations, monthend contents for 30 lakes and reservoirs, water quality for 18 gaging stations, and water levels for 106 observation wells. Also included are data for 20 low-flow and 19 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States are also included in this report. (USGS)
W84-03627

WATER RESOURCES DATA IDAHO, WATER YEAR 1982: VOLUME 2. UPPER COLUMBIA RIVER BASIN AND SNAKE RIVER BASIN BELOW KING HILL,
Geological Survey, Boise, ID. Water Resources Div.
R. W. Harper, H. G. Sisco, I. O'Dell, and S. C. Cordes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 118488. USGS Water-Data Report ID-82-2, 1983. 292 p, 22 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Upper Columbia River basin, Snake River basin.

Water resources data for the 1982 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage only for 10 lakes and reservoirs; contents only for 11 lakes and reservoirs; water quality for 27 gaging stations, 38 partial-record stations, 143 wells; and water levels for 458 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W84-03628

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 1: ARKANSAS RIVER BASIN, RED RIVER BASIN, SABINE RIVER BASIN, NECHES RIVER BASIN, TRINITY RIVER BASIN AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 158741, USGS Water Data Report TX-81-1, 1982. 597 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, Arkansas River basin, Red River basin, Sabine River basin, Neches River basin, Trinity River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03629

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 2. SAN JACINTO RIVER BASIN, BRAZOS RIVER BASIN, SAN BERNARD RIVER BASIN, AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 152017, USGS Water-Data Report TX-81-2, 1982. 511 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, San Jacinto River basin, Brazos River basin, San Bernard River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03630

WATER RESOURCES DATA TEXAS, WATER YEAR 1981: VOLUME 3. COLORADO RIVER BASIN, LAVACA RIVER BASIN, GUADALUPE RIVER BASIN, NUECES RIVER BASIN, RIO GRANDE BASIN, AND INTERVENING COASTAL BASINS.
Geological Survey, Austin, TX. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 152025. USGS Water-Data Report TX-81-3, 1982. 599 p, 1 Fig.

Descriptors: *Texas, *Hydrologic data, *Surface water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water analyses, *Data collection, Colorado River basin, Lavaca River basin, Guadalupe River basin, Nueces River basin, Rio Grande River basin.

Surface-water data for the 1981 water year for Texas are presented in three volumes, appropriately identified as to content by river basins. Data in each volume consist of records of stage, discharge, and water quality of streams and canals; and stage, contents, and water quality of lakes and reservoirs. Also included are crest-stage and flood-hydrograph partial-record stations, reconnaissance partial-record stations, and low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering States also are included. (USGS)
W84-03631

WATER RESOURCES DATA WYOMING, WATER YEAR 1982,
Geological Survey, Cheyenne, WY. Water Resources Div.
E. S. Denison, J. R. Schuetz, and S. J. Rucker, IV.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 114669. USGS Water Data Report WY-82-1, (1983). 504 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collection.

Water resources data for the 1982 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 185 gaging stations; stage only for records for 1 lake; stage and contents for 14 lakes and reservoirs; water quality for 85 gaging stations, and 61 ungaged stations; and water levels for 36 observation wells. Also included are 32 crest-stage partial-record stations and 1 precipitation monitoring site. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03632

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOL. 1. COLORADO RIVER BASIN, SOUTHERN GREAT BASIN FROM MEXICAN BORDER TO MONO LAKE BASIN, AND PACIFIC SLOPE BASINS FROM TIJUANA RIVER TO SANTA MARIA RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 466. USGS Water-Data Report CA-81-1, 1982. 417 p, 6 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1981 water year for California consists of records of stage, discharge, and water quality of stream; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 1 contains discharge records for 169 gaging stations; stage and contents for 19 lakes and reservoirs; water quality for 42 streams and 21 wells; water levels for 169 observation wells. Also included are 10 crest-stage partial-record stations. (USGS)
W84-03633

WATER RESOURCES CALIFORNIA, WATER YEAR 1981: VOLUME 2. PACIFIC SLOPE BASINS FROM ARROYO GRANDE TO OREGON STATE LINE EXCEPT CENTRAL VALLEY.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 474. USGS Water-Data Report CA-81-2, 1982. 513 p, 3 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data in this volume for the 1981 water year consists of records of stage discharge, and water quality of streams and wells; stage, contents, and water quality in lakes and reservoirs; and water levels in wells. This report contains discharge records for 162 gaging stations; stage and contents for 12 lakes and reservoirs; water quality for 63 stations and 27 wells; water levels for 78 observation wells. Also included are 1 low-flow partial-record station and 32 water quality partial-record stations. (USGS)
W84-03634

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOL. 3. SOUTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM WALKER RIVER TO TRUCKEE RIVER.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 482. USGS Water-Data Report CA-81-3, 1982. 419 p, 12 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1981 water year for California consists of records of stage, discharge, gage-height, and water quality of streams; stage, contents and water quality of lakes and reservoirs; water levels and water quality of wells. Volume 3 contains discharge records for 158 gaging stations; stage and contents for 50 lakes and reservoirs; gage height records for 2 lakes; water quality for 23 stations; water levels for 54 observation wells, and water quality for 7 wells. Also included are 11 crest-stage partial-record stations and two water-quality partial-record stations. (USGS)
W84-03635

WATER RESOURCES DATA CALIFORNIA, WATER YEAR 1981: VOLUME 4. NORTHERN CENTRAL VALLEY BASINS AND THE GREAT BASIN FROM HONEY LAKE BASIN TO OREGON STATE LINE.
Geological Survey, Sacramento, CA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 174 458. USGS Water-Data Report CA-81-4, 1982. 359 p, 12 Fig.

Descriptors: *California, *Hydrologic data, *Surface water, *Water quality, *Groundwater, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1981 water year for California consists of records of stage, discharge, and water quality of streams; stage and contents in lakes and reservoirs; and water levels and water quality in wells. Volume 4 contains discharge records for 167 gaging stations; stage and contents for 26 lakes and reservoirs; precipitation data for 2 stations; water quality for 17 stations; water levels for 55 observation wells, and water quality for 18 wells. Also included are 4 crest-stage partial-record stations and 7 low-flow partial-record stations. Additional water data are collected at various sites, not part of the systematic data collection program, and are published as special investigations. (USGS)
W84-03636

WATER RESOURCES DATA IDAHO, WATER YEAR 1982: VOLUME 1. GREAT BASIN AND SNAKE RIVER BASIN ABOVE KING HILL,
Geological Survey, Boise, ID. Water Resources Div.
R. W. Harper, H. G. Sisco, I. O'Dell, and S. C. Cordes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 118 470. USGS Water-Data Report ID-82-1, 1983. 332 p, 12 Fig.

Descriptors: *Idaho, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Smoke River basin, Great Basin.

Water resources data for the 1982 water year for Idaho consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report in two volumes contains discharge records for 192 gaging stations; stage only records for 2 gaging stations; stage only for 10 lakes and reservoirs; contents only for 11 lakes and reservoirs; water quality for 27 gaging stations, 38 partial-record stations, 143 wells; and water levels for 458 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Idaho. (USGS)
W84-03637

WATER RESOURCES DATA ALASKA, WATER YEAR 1982,
Geological Survey, Anchorage, AK. Water Resources Div.
R. D. Lamke, P. J. Still, B. B. Bigelow, H. R. Seitz, and J. E. Vaill.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 119569. U.S.G.S. Water-Data Report AK-82-1, (1983). 363 p, 4 Fig.

Descriptors: *Alaska, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Alaska consists of records of stage, discharge, and water quality of streams; stage and water quality of lakes; and water levels and water quality in wells and springs. This report contains discharge records for 108 gaging stations; stage only record for 1 gaging station; water quality for 49 stations; and water levels for 28 observation wells. Also included are 43 low-flow, 67 crest-stage, and 48 water-quality partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements of discharge, lake stage, or water quality. (USGS)
W84-03638

WATER RESOURCES DATA WYOMING, WATER YEAR, 1981: VOLUME 1. MISSOURI RIVER BASIN.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170 944. USGS Water-Data Report WY-81-1, 1982. 575 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water Temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 1 of this report contains discharge records for 155 gaging stations; stage only for records for 1 lake, stage and contents for 11 lakes and reservoirs; water quality for 89 gaging stations, and 45 ungaged stations; and water levels for 33 observation wells. Also included are 75 crest-stage partial-record stations and 2 precipitation monitoring sites. Additional water data were collected at various sites, not part of the systematic data collection

program, and are published as miscellaneous measurements. (USGS)
W84-03639

WATER RESOURCES DATA WYOMING, WATER YEAR 1981: VOLUME 2. GREEN RIVER BASIN, BEAR RIVER BASIN, AND SNAKE RIVER BASIN.
Geological Survey, Cheyenne, WY. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 170 951. USGS Water-Data Report WY 81-2, 1982. 219 p, 4 Fig.

Descriptors: *Wyoming, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow-rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Wyoming consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. Volume 2 of this report contains discharge records for 62 gaging stations; stage and contents for 3 lakes and reservoirs; water quality for 30 gaging stations and 15 ungaged stations; and water levels for 7 observation wells. Also included are 24 crest-stage partial record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements and analyses. (USGS)
W84-03640

WATER RESOURCES DATA ILLINOIS, WATER YEAR 1982: VOLUME 1. ILLINOIS EXCEPT ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
R. L. Stahl, K. K. Fitzgerald, T. E. Richards, and P. D. Hayes.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 112. USGS Water-Data Report IL-82-1, 1983. 496 p.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 92 gaging stations; stage at 17 gaging stations; stage and contents at 3 lakes and reservoirs, stage only at 1 lake station; and water quality at 117 gaging stations. Also included are data for 11 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 2 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W84-03641

WATER RESOURCES DATA ILLINOIS, WATER YEAR 1982: VOLUME 2. ILLINOIS RIVER BASIN,
Geological Survey, Urbana, IL. Water Resources Div.
T. E. Richards, P. D. Hayes, R. L. Stahl, and K. K. Fitzgerald.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 120. USGS Water-Data Report IL-82-2, 1983. 401 p, 4 Fig.

Descriptors: *Illinois, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, *Illinois River basin.

Water resources data for the 1982 water year for Illinois consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of groundwater wells. This volume contains records for water discharge at 83 gaging stations; stage only at 2 gaging stations; stage only at 3 lake stations; water quality at 96 gaging stations; and water levels at 3 observation wells. Also included are data for 18 crest-stage partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. These data together with the data in Volume 1 represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Illinois. (USGS)
W84-03642

WATER RESOURCES DATA WEST VIRGINIA, WATER YEAR 1982,
Geological Survey, Charleston, WV. Water Resources Div.
W. N. Embree, E. A. Friel, T. A. Ehlke, and S. M. Ward.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120161. USGS Water-Data Report WV-82-1, (1983). 342 p, 5 Fig.

Descriptors: *West Virginia, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for West Virginia consist of records of stage, discharge, and water quality of streams and springs; stage and contents of lakes and reservoirs; and water levels in wells. This report contains discharge records for 116 gaging stations; stage only records for 9 gaging stations; stage and contents for 8 lakes and reservoirs; contents for 1 reservoir; change in contents for 1 reservoir; water quality for 55 gaging stations; and water levels for 29 observation wells. Also included are 2 crest-stage partial-record stations, and 1 low-flow partial record station. Additional water data were collected at various sites, not part of the systematic data collections program, and are published as miscellaneous measurements and analysis. (USGS)
W84-03643

WATER RESOURCES DATA NEVADA, WATER YEAR 1981.
Geological Survey, Carson City, NV. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 310. USGS Water-Data Report NV-81-1, 1982. 404 p, 10 Fig.

Descriptors: *Nevada, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoir, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data published herein for the 1981 water year comprise the following records: water discharge for 132 gaging stations on streams, canals, and drains; discharge data for 82 peak-flow stations and 7 low-flow stations on streams; stage and contents for 21 lakes and reservoirs; water levels for 235 observation wells; and water-quality data for 106 stream, canal, and drain sites, 13 lake and reservoir sites, and 4 wells. Additional water data, collected at various sites that are not part of the systematic data-collection program, are published as miscellaneous measurements. (USGS)
W84-03644

WATER RESOURCES DATA NEW HAMPSHIRE AND VERMONT, WATER YEAR 1981.
Geological Survey, Boston, MA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 229 310, USGS Water-Data Report NH-VT-81-1, 1982. 167 p, 4 Fig, 1 Tab.

Descriptors: *New Hampshire, *Vermont, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water-resources data for the 1981 water year for New Hampshire and Vermont consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 75 gaging stations, stage records for 3 lakes, monthend contents for 25 lakes and reservoirs, water-quality data for 4 gaging stations, and water levels for 30 observation wells. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States and Province of Quebec are also included in this report.
W84-03645

WATER RESOURCES DATA TENNESSEE, WATER YEAR 1982,
Geological Survey, Nashville, TN. Water Resources Div.
J. R. Lowery, P. H. Counts, H. L. Edmiston, and F. D. Edwards.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 111 459. USGS Water-Data Report TN-82-1, (1983). 379 p, 6 Fig, 1 Tab.

Descriptors: *Tennessee, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediment analyses, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Tennessee consist of records of stage, discharge, and water quality of streams and springs; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of wells. This report contains discharge records for 112 gaging stations; stage only records for one lake gaging station; elevation and contents for 28 lakes and reservoirs; water quality for 70 stations and 77 wells; and water levels for 30 observation wells. Also included are 126 crest-stage partial-record stations and 23 low-flow partial-record stations. Additional water data were collected at various stream and spring sites not involved in the systematic data collection program and are published as miscellaneous measurements and analyses, or as seepage investigations of discharge and water quality. (USGS)
W84-03646

WATER RESOURCES DATA WISCONSIN, WATER YEAR 1982,
Geological Survey, Madison, WI. Water Resources Div.
B. K. Holmstrom, C. A. Harr, and R. M. Erickson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 243 915. USGS Water-Data Report WI-82-1, (April, 1983). 426 p, 5 Fig.

Descriptors: *Wisconsin, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water-resources data for the 1982 water year for Wisconsin include records of stream-flow at gaging stations, partial-record stations, and miscel-

laneous sites, records of chemical, physical, and biological characteristics of surface water, ground water, and precipitation, and records of water levels in observation wells. Records for a few gaging stations in bordering states also are included. (USGS)
W84-03647

WATER RESOURCES DATA UTAH, WATER YEAR 1982,
Geological Survey, Salt Lake City, UT. Water Resources Div.
M. D. ReMillard, G. C. Anderson, E. Hookano, Jr., and G. W. Sandberg.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84 120 484. USGS Water-Data Report UT-82-1 (1983).

Descriptors: *Utah, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1982 water year for Utah consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels and water quality of ground water. This report contains discharge records for 233 gaging stations; stage and contents for 19 lakes and reservoirs; water quality for 45 hydrologic stations, and 185 wells; miscellaneous temperature measurements and field determinations for 167 stations; and water levels for 39 observation wells. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03648

WATER RESOURCES DATA ARKANSAS, WATER YEAR 1981.
Geological Survey, Little Rock, AR. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83 201657. USGS Water-Data Report AR-81-1, 1982. 583 p, 5 Fig, 3 Tab.

Descriptors: *Arkansas, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Arkansas consist of records of gage height, discharge, and water quality of streams; elevation, contents, and water quality of lakes; water levels and water quality of observation wells. This report contains discharge records for 56 gaging stations; elevation and contents for 4 lakes, water quality for 160 gaging stations, 51 partial-record stations, 9 observation wells, 12 lakes; and water levels for 79 observation wells. Also included are 125 crest-stage partial record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-03649

RECORDS OF WATER-LEVEL MEASUREMENTS AND LITHOLOGIC LOGS, RED RIVER VALLEY, LOUISIANA, 1975-80,
Geological Survey, Baton Rouge, LA. Water Resources Div.
C. W. Smoot.
Louisiana Department of Transportation and Development, Baton Rouge. Water Resources Basic Records Report No. 12, 1983. 197 p, 6 Fig, 18 Tab, 9 Ref.

Descriptors: *Alluvial aquifer, *Lithologic logs, *Water levels, Artesian wells, Water-table wells, Data collection, *Red River alluvial aquifer, *Louisiana, Terrace, Aquifer.

Navigation structures are planned for the Red River in Louisiana. Water levels measured in the Red River alluvial aquifer from January 1975 to December 1980 document preconstruction water-level fluctuations in wells in the aquifer. Water levels are recorded for 417 wells. In addition, lithologic logs for 124 wells or test holes are compiled to define the aquifer and confining bed. (USGS)
W84-03675

ADDENDUM TO THE SURFACE WATER QUALITY REPORT,
Disko (M.) Associates, Union, NJ.
For primary bibliographic entry see Field 5B.
W84-03678

GROUND-WATER RESOURCES IN THE CENTRAL PART OF THE FLATHEAD INDIAN RESERVATION, NORTHWESTERN MONTANA,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03680

TECHNICAL MANUAL FOR ESTIMATING LOW-FLOW CHARACTERISTICS OF PENNSYLVANIA STREAMS,
Geological Survey, Harrisburg, PA. Water Resources Div.
H. N. Flippo, Jr.
Pennsylvania Department of Environmental Resources, Harrisburg, Water Resources Bulletin No. 15, October, 1982. 86 p, 2 Fig, 34 Tab, 15 Ref.

Descriptors: *Regional analysis, *Frequency analysis, *Regression analysis, *Low flow, Flow characteristics, Statistical models, *Pennsylvania, Delaware River basin, Susquehanna River basin, Ohio River basin, Potomac River basin, St. Lawrence River basin.

Regional regression equations are provided for estimation of annual low-flow discharges for 3-, 7-, 30-, and 120-day durations for recurrence intervals of 5, 10, 20, 50, and 100 years, respectively. Monthly regression equations, for six individual months of May through October, are provided for estimation of average minimum discharges for 1, 3, 7, and 30 days and the same recurrence intervals. These regression equations are applicable to most unregulated streams for which low-flow discharge records are unavailable. Drainage area, a geologic index, channel slope, and a precipitation index serve as independent variables in the regressions. Observed standard errors of regression are mostly in the range of 20 to 50 percent. This manual contains 15 references. (USGS)
W84-03688

GEOHYDROLOGY AND WATER USE IN SOUTHERN APACHE COUNTY, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-03690

ESTIMATED IRRIGATION WATER USE IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
R. M. Spechler.
Florida Bureau of Geology, Tallahassee, Map Series No. 106, 1983. 1 sheet map, 4 Fig, 1 Tab, 21 Ref.

Descriptors: *Water use, *Irrigation water, *Estimated use, *Florida, *Maps.

Estimated freshwater use in Florida averaged 7,309 million gallons per day in 1980. Approximately 41 percent, 2,997 million gallons per day, was withdrawn for irrigation of 2,041,400 acres. This is an increase of approximately 2,631 million gallons per day, more than eight times the amount used in 1950. About 1,574 million gallons per day, about 53 percent of the total, was from ground water. The remaining 1,423 million gallons per day came from surface-water sources. The largest use of water for irrigation was in central and southern Florida, where seven counties representing 56 percent of the irrigated land available for farming accounted for 60 percent of all irrigated water use during 1980. The smallest use of water for irrigation was in the northern part of the State, where 30 counties reported a combined water use of only 46 million gallons per day, or 2 percent of the water used for irrigation. Citrus is the major irrigated crop in the State, accounting for 30 percent of the total irrigated acreage. Pasture and sugarcane accounted for 24 and 23 percent, respectively. (USGS)
W84-03696

AVERAGE ANNUAL RAINFALL AND RUNOFF IN GEORGIA, 1941-70,
Geological Survey, Atlanta, GA. Water Resources Div.
R. F. Carter, and H. R. Stiles.
Georgia Department of Natural Resources, Atlanta, Hydrologic Atlas No. 9, 1983. 1 sheet map, 11 Ref.

Descriptors: Rainfall, *Runoff, Evapotranspiration, *Hydrologic cycle, Flow variability, *Georgia, *Maps, Rainfall maps, Runoff maps, Evaporation maps.

Maps showing average rainfall and runoff for the period 1941-70 for Georgia are presented. Annual rainfall averages 50 inches, runoff averages 15 inches, and evapotranspiration averages 35 inches. Average annual rainfall is as much as 76 inches in the northeast, but elsewhere is within about 10 percent of the statewide average of 50 inches. Annual average runoff is as much as 44 inches in the northeast and varies as much as 50 percent from the statewide average of 15 inches elsewhere. Runoff is different for each physiographic province, varying from 58 percent of the rainfall in the Blue Ridge province in the north to 24 percent of the rainfall in the Coastal Plain. Runoff also varies from year to year, but is more variable in the south than in the north. The standard deviation of the average annual runoff is as much as 67 percent of the mean for some stream gages in the south and is as little as 19 percent of the mean for some stream gages in the north. (USGS)
W84-03698

GUIDE TO THE LARVAE OF THE NEARCTIC DIAMESINAE (DIPTERA:CHIRONOMIDAE): THE GENERA BOREOHEPTAGYIA, PROTANYPUS, DIAMESA, AND PSEUDOKIEFFERIELLA,
Geological Survey, Doraville, GA. Water Resources Div.
J. S. Doughman.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $7.75 paper in copy, $3.50 in microfiche. USGS Water-Resources Investigations Report, 83-4006, 1983. 58 p, 40 Fig, 46 Ref.

Descriptors: *Aquatic insects, Taxonomy, Distribution, *Indices, Diptera, Chironomidae, Diamesinae, Larvae, Arctic, Alpine regions.

The subfamily Diamesinae consists of the monogeneric tribes Boreoheptagnini and Parotanypini and the diverse tribe Diamesini with seven genera. These midges are prevalent in clean, cool arctic-alpine waters, but less abundant in the lowlands. Keys and descriptions herein to the known species of these nine genera may prove valuable in the biomonitoring of these cool aquatic habitats. The larvae of Protanypus saetheri Wiederholm is described for the first time. Identification is based upon the absence of other species in the collection area. Examination of a series of larval D. incallida Walker collected in Wyoming and a review of pertinent literature shows that there is considerable variation in the procerus and the labral armature. Because these characters are often used in keys, this variability can lead to misidentification of less recognizable species of Diamesa. (USGS)
W84-03848

8. ENGINEERING WORKS

8A. Structures

COOLING WATER FACILITIES AT A NUCLEAR STATION,
Arizona Public Service Co., Phoenix.
W. L. Hurst, B. M. Ghadiali, and J. S. Kanovich.
Journal of Energy Engineering (ASCE), Vol. 109, No. 1, p 1-6, March, 1983. 3 Fig.

Descriptors: *Cooling water, *Nuclear powerplants, Cooling ponds, Wastewater facilities, Design criteria, Costs analysis, Comparison studies.

The use of ponds for holding a reserve of cooling water obtained as sewage effluent and also for collection of waste water for disposal by evaporation, was made at a nuclear power plant site in southern Arizona. The power output of the plant will be 3,900 MW. Two single cell ponds are 80 acres (30 ha) and 250 acres (100 ha) in size. Excavated materials from the 80-acre (30-ha) pond were used for structural backfill as planned, and the 250-acre (100-ha) pond was designed for limited dike height with balanced cut and fill and some excess materials used as side berms for additional safety. Both ponds are being lined with a unique combination of linings to provide environmental safeguards and at the same time cost-effectiveness is compared to alternative schemes. (Author's abstract)
W84-03712

UPLIFT PRESSURE IN CRACK BELOW DAM,
California Univ., Berkeley. Dept. of Civil Engineering.
R. E. Goodman, B. Amadei, and N. Sitar.
Journal of Energy Engineering (ASCE), Vol. 109, No. 4, p 207-221, December, 1983. 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Uplift pressure, *Dams, *Cracks, Flow, Drains, Dam foundations, Drain spacing, Hydraulic head, Hydraulic models, Mathematical models.

A specific analytical solution for flow through a horizontal crack of finite length drained by a series of vertical drains is presented. The solution is used to derive diagrams of uplift pressure on the base of a dam and to demonstrate the influence of drains on the distribution and magnitude of uplift forces. Our solution shows that there should be an almost linear drop in hydraulic head from the entrance to the crack at the heel of the dam to the line of drains, followed by a slight rise in head to the end of the crack. This is consistent with a previosly suggested solution for porous media. The results show that drain holes are effective in substantially reducing uplift pressures in a crack and have the greatest influence when located between approximately one half and one fifth of the length of the crack from its upstream end. (Author's abstract)
W84-03715

MAIN DIRECTIONS IN EFFICIENT DAM CONSTRUCTION IN THE NORTH,
For primary bibliographic entry see Field 8D.
W84-03765

PROVISION OF RELIABILITY OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W84-03766

HIGH-HEAD REGULATING DIAPHRAGM-GATE,
L. L. Dol'nikov, S. V. Seleznev, and N. V. Shragin.
Hydrotechnical Construction, Vol. 17, No. 8, p 435-438, August, 1983. 4 Fig, 3 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 37-39, August, 1983.

Descriptors: *Gates, *Spillways, *Construction, Design criteria, Diaphragm gates, Hydroelectric plants, Powerplants, Reservoirs.

The cost of high-head hydrostations can be substantially reduced by combining the temporary and operating spillways, but difficulties arise due to the need to close the large openings at a full head after filling the reservoir. Design studies and experimental investigations were conducted to evaluate the prospects of using a diaphragm-gate as the main gate of a deep high-head spillway at a head of 100-200 m and discharge of 500-2000 cubic m/sec. Advantages of the diaphragm gate as opposed to the radial gate include the possibility of rapid reconstuction of the orifice for reducing its area. The use of the diaphragm gate is especially effective where it makes it possible to eliminate the construction of a second level of the spillway and to convert the temporary spillway into an operating spillway. During permanent operation the diaphragm can be sealed off and thereby expenses on repair of the seals can be eliminated and the reliability of the gate chamber increased. The possibility of closing large orifices by this gate makes it promising when developing the hydropower resources of the large rivers of Siberia and the Far East. (Baker-IVI)
W84-03913

USE OF ROCK ANCHORS TO HEIGHTEN A CONCRETE DAM.
International Water Power and Dam Construction, p 36, March, 1984. 3 Fig.

Descriptors: *Dam construction, *Anchors, Reservoirs, Storage reservoirs, Concrete dams, Sebakwe Dam, Zimbabwe.

Increasing storage capacity of a reservoir by raising the height of its retaining dam can be an effective way of meeting increased requirements for water or energy. Sebakwe Dam is the largest dam in the midlands of Zimbabwe. The optimal method of increasing the supply of water to this area would be by raising the height of the dam by an effective 6 m, doubling its storage capacity and thereby increasing its yield. Rock anchors were set vertically and positioned about 1 to 2 m from the upstream face of the dam. The nine central spillway blocks have two anchors each, while the non-overflow blocks on each flank generally have four or five each. Construction began on the $13.5 million contract in June 1982 and is expected to be completed by early 1985. (Baker-IVI)
W84-04080

8B. Hydraulics

UPLIFT PRESSURE IN CRACK BELOW DAM,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W84-03715

FORMATION AND EFFECTS OF ALTERNATE BARS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
M. N. R. Jaeggi.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 142-156, February, 1984. 7 Fig, 38 Ref, 1 Append.

Descriptors: *Alternate bars, *Bar formation, *River flow, River regulation, Velocity, Bed load, Scour, Slope, Grain size, Channel morphology, Armoring, Flow resistance, Equations, Sediment transport, Flow resistance.

Major river regulation works have often resulted in alternate bar formation. Experimental work is described which provides more information on this phenomenon. Alternate bar formation is closely associated with meandering, inferring that alternate bar formation is caused by flow induced periodic disturbances of the horizontal velocity profile. Based on these considerations a criterion has been developed which defined the upper limit of alternate bar formation, and this has been satisfactorily compared to other formation criteria and experimental data. The lower limit is given by the initiation of bedload transport. A simple relation between slope, channel width and grain size is then deduced to indicate whether for a given channel, alternate bars can develop for any discharge. This relation takes into account armoring effects. Another equation is proposed to predict the scour depth resulting from alternate bar formation. Such scour often induces costly river maintenance works. Finally, some interesting results of flow resistance have been found, leading to a tentative equation for the intermediate roughness range. (Author's abstract)
W84-03719

MODELING OF RIVER CHANNEL CHANGES,
H. H. Chang.
Journal of Hydraulic Engineering, Vol. 110, No. 2, p 157-172, February, 1984. 10 Fig, 17 Ref, 1 Append.

Descriptors: *Channels, *Mathematical models, *Model studies, *River beds, Simulation, Flood routing, Sediment routing, Bed profile, Power expenditure, Sediment transport.

A computer-based flood- and sediment-routing model which simulates river channel changes is described together with its application in the case study of a disturbed river. Simulation results of this study are supported by field observations and measurements. This model incorporates the interrelated changes in channel bed profile, width, and lateral migration in channel bends. These changes reflect, in part, a river's adjustments in power expenditure. The interrelation of changes in channel bed profile and width is illustrated by a physical example and explained by the river's tendency to establish equal power expenditure along the channel. Such power transformation associated with river channel evolution tends to restore the dynamic equilibrium in sediment transport, that is, equal sediment load along the channel. The case study demonstrates that in the case of severely disturbed rivers, flood-level computation using a fixed-bed model may be quite inaccurate and improved accuracy can be provided by an erodible-bed model. (Author's abstract)
W84-03720

CELLULAR SECONDARY CURRENTS IN STRAIGHT CONDUIT,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
I. Nezu, and H. Nakagawa.
Journal of Hydraulic Engineering (ASCE), Vol. 110, No. 2, p 173-193, February, 1984. 20 Fig, 1 Tab, 19 Ref.

Descriptors: *Hydraulic engineering, *Flow pattern, *Conduits, Sedimentation, *Water currents, Flow, Open-channel flow, River beds.

Cellular secondary currents are important in hydraulic engineering because these currents might cause three-dimensional sediment distributions and bedforms in a straight river. An investigation was made of the structure of cellular secondary currents in air conduit flow because the turbulent measurements of air flow by hot wires are much easier and much more accurate than those of water flow by hot films. Considering an essential interaction between secondary currents and bedform, longitudinal ridge elements were attached onto both lower and upper bottoms of the conduit, which simulated the longitudinal ridges and trough of river bedform. All three components of the velocity were measured accurately by hot-wire anemometers. The structure of secondary currents was examined through the equations of mean flow vorticity and mean flow energy. When the spanwise spacing of the ridges is set equally to that of the sand ribbons in a river, cellular secondary currents similar to those of open channel are reproduce fairly well in air conduit, although the intensity of these currents is somewhat depressed near the symmetrical plane due to the absence of free surface. The Reynolds stress term is nearly balanced with the production term of vorticity in most of the cell structure. A closed region of low pressure occurs over the ridges where the intense upflow is produced. This feature is consistent with that of

kolk-vortex and tornado motion in geophysical flows. (Baker-IVI)
W84-03721

OPTIMAL CONTROL PROBLEMS IN TIDAL POWER,
Reading Univ. (England). Dept. of Mathematics.
N. Birkett, B. M. Count, and N. K. Nichols.
International Water Power and Dam Construction, Vol. 36, No. 1, p 37-42, January, 1984. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Tidal powerplants, *Optimization, Systems analysis, Powerplants, Estuaries, Tidal estuaries, Water resources development, Planning, Decision making, Severn Barrage, England.

There have been a number of studies to investigate the feasibility of using the tidal energy in the Severn Estuary to produce electricity. The most recent study concludes that a Severn Barrage is technically feasible, and could be economically attractive. The economic arguments have been hotly debated; in such evaluations both the component costs and energy produced must be determined accurately and this has posed a complex optimization problem. A theory for optimal control that has general application to problems in tidal power has been developed which incorporates the estuarine dynamics into the optimization. Optimized performance of two-way generation schemes could be superior to that of ebb generation, although the efficiency loss of the turbines designed for reverse operation has not been taken into consideration. (Baker-IVI)
W84-03726

INVESTIGATING ASYMMETRIC FLOWS,
Benin Univ., Benin City (Nigeria). Faculty of Engineering.
L. A. Salami.
International Water Power and Dam Construction, Vol. 36, No. 1, p 46-57, January, 1984. 6 Fig, 4 Tab, 4 Ref.

Descriptors: *Fluid mechanics, *Flow, Velocity profiles, Computers, Velocity, Statistical analysis, Mathematical studies.

Areas of asymmetric flow measurement which are difficult to study experimentally have been explored using theoretical velocity profiles and computer programs. A statistical analysis was used to decide which of the various velocity-area methods is best based on the result of 23 theoretical profiles developed and the problems of their practical application. The same method was used to investigate the best arrangement of points to traverse an asymmetric flow. The velocity-area methods studied include AMCA, cubic, log-linear, log-Tchebycheff and log-cubic. The most important parameter in traversing an asymmetric flow is the spread of radii used for traversing, i. e. the array of radii. The optimum is six radii. Of lesser importance is the number of traverse points, provided it is more than four, and the velocity-area method, provided one of the five assessed in this investigation is used. The log-Tchebycheff method had a slight edge over other methods. Errors from mispositioning can be quite large, and increasing the number of traverse points per radius did not necessarily reduce the error. Traversing along a diameter gives a much better result than along a radius but this conclusion may depend on experimental conditions. (Baker-IVI)
W84-03728

STABILITY OF CHANNELS OF LARGE CANALS ON LARGE-SCALE ERODIBLE MODELS,
A. M. Mukhamedov, T. Zh. Zhuraev, and Kh. Kh. Ishanov.
Hydrotechnical Construction, Vol. 17, No. 8, p 405-410, August, 1983. 3 Fig, 2 Tab, 9 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 21-23, August, 1983.

Descriptors: *Channel erosion, *Model studies, *Stability, *Canals, Construction, Design criteria, Erosion control, Channels, Soil properties, Flow velocity.

The design of large canals requires an examination of numerous problems, including the determination of optimal average noneroding velocity of the flow for cohesionless soils of the canal bed; establishment of the most advantageous channel form parameter for which transverse and longitudinal deformation of the canal is precluded; the selection of the roughness coefficient for large canals whose channel is composed of sand and subjected to local deformations. Experimental findings suggest the deformation of sand canals to a considerable extent is determined by the initial form of the channel and hydraulic elements. Deformation of sand canals with specified initial elements and with a particular relative roughness of the channel on the model occurs quite slowly, with stabilization of the stream gradient. The average depths and values of the Froude and Reynolds numbers hardly change during the observed deformations of the investigated channels. During channel deformation small changes in the bottom relief and kinematic structure of the flow are noted and redistribution of the fractional composition of the soil with subsequent stabilization of all elements of the flow and channel is observed. (Baker-IVI)
W84-03909

HYDRODYNAMIC LOADS AND STABILITY OF THE LOWER-POOL APRON OF HYDRAULIC STRUCTURES,
O. N. Chernykh, and L. V. Komel'kov.
Hydrotechnical Construction, Vol. 17, No. 8, p 410-416, August, 1983. 6 Fig, 5 Ref. Translated from Gidrotehknicheskoe Stroitel'stvo, No. 8, p 24-28, August, 1983.

Descriptors: *Hydraulic structures, *Design criteria, *Aprons, Conduits, Hydrodynamics, Stability, Reynolds number.

The main types of structures on reclamation systems are closed conduit offtake regulators and transitions. Weirs with pipe outlets are also being constructed for creating reservoirs and ponds. The structures of the lower pool are often insufficiently reliable, and cases of deformation of the baffle platform and destruction of the lining within the limits of the apron are common. Theoretical and experimental investigations have been performed to determine the characteristics of the dynamic effect of flow on protective elements associated with the lower pool apron of hydraulic structures beyond the energy dissipators and to evaluate the stability of the protective platforms and the water saturated foundation under them. The experiments were conducted on devices providing values of Reynolds numbers in the lower pool from 20,000 to 75,000. The proposed designs of the protective cover of the lower pool resulting from these studies in expanding channels, the method of determining the loads on its elements, and the developed method of estimating the stability of the cover are being used in the design of a number of reclamation structures. (Baker-IVI)
W84-03910

CALCULATION OF THE PROTECTIVE FACING OF SLOPES OF HYDRAULIC STRUCTURES WITH CONSIDERATION OF WIND-WAVE REFRACTION,
M. E. Plakida.
Hydrotechnical Construction, Vol. 18, No. 8, p 429-432, August, 1983. 3 Fig, 1 Tab, 5 Ref. Translated from Gidrotehknicheskoe Stroitel'stvo, No. 8, p 34-36, August, 1983.

Descriptors: *Shore protection, *Waves, *Hydraulic structures, *Erosion control, Erosion, Wind, Shores, Reservoirs, Rockfill structures, Model studies.

Consideration of refraction of waves during their oblique approach to a slope-type structure compared to the frontal approach of waves makes it possible to lighten the protective revetment of the slope from the damaging action of waves. This is achieved by the fact that the impact of a wave when it breaks on a slope is dispersed in time and space, and also the run-up of the wave on the slope of the structure. Laboratory investigations to evaluate the oblique approach of waves to a rockfill slope, despite their limitedness (small scale of the model or investigation only at one gradient of the slope, equal to 1.5), show the economic expediency of taking into consideration wave refraction in such cases. Equations are derived which are recommended for calculating refraction and the mass of stone for protecting slopes from waves in the case of their oblique approach. (Baker-IVI)
W84-03911

PROVISION OF RELIABILITY OF SURPLUSING AND OUTLET WORKS OF LARGE HYDROELECTRIC SCHEMES,
L. D. Lentyaev, and L. V. Smirnov.
Hydrotechnical Construction, Vol. 17, No. 8, p 439-442, August, 1983. 3 Fig, 5 Ref. Translated from Gidrotechnicheskoe Stroitel'stvo, No. 8, p 40-41, August, 1983.

Descriptors: *Spillways, *Floods, *Erosion control, *Reliability, Cavitation, Hydraulic structures, Design criteria, Prediction.

During its planned service life, a spillway should guarantee to a certain degree of reliability the passage of flood discharges without the creation of an emergency situation for other structures which are part of the same hydroelectric scheme. To ensure this, the discharge of water must first be determined as well as the time when larger discharges are likely to occur in the period of the guaranteed, no-failure operation of the spillway. Attention must be given to erosion in the lower pool, to hydrodynamic loads on elements of the spillway passage, and to the cavitation phenomenon. (Baker-IVI)
W84-03914

INCREASE OF ELECTRIC POWER PRODUCTION AT THE KHRAMI-I HYDROELECTRIC STATION BY RETURN OF RESERVOIR SEEPAGE WATER,
V. M. Nasberg.
Hydrotechnical Construction, Vol. 11, No. 8, p 443-447, August, 1983. 5 Ref. Translated from Gidrotekhnickeskoe Stroitel'stvo, No. 8, p 54-56, August, 1983.

Descriptors: *Pumping, *Reservoir, *Seepage, *Khrami Hydrostation, Hydroelectric plants, Powerplants, Energy.

Studies conducted at the Khrami-I hydrostation indicate that pumping of water being lost due to seepage from the reservoir with return of this water to it will make it possible to increase electric power production by 17% with a payback period of the investments in the structures for pumping of less than the standard. Pumping will be from the lower level with a discharge equal to or greater than the discharge of all seepage water with return of the pumped water to the reservoir or diversion tunnel. The water being pumped should be stored in the reservoir not longer than 5-10 days, using it as needed for covering the peaks of the daily and weakly load curve of the power system. On converting the reservoir operating regime to the design regime it is best to control production loses due to seepage by a combined method consisting of cutoff measures on the reservoir banks with pumping of all seepage water into the diversion tunnel or reservoir. Cutoff measures in the floodplain part of the reservoir are difficult to accomplish and insufficiently long-lived. Groundwater pumping can be used for increasing the production of energy by other mountain hydrostations as well. (Baker-IVI)
W84-03915

DESIGN OF ENERGY-EFFICIENT PIPE-SIZE EXPANSION,
Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
G. E. Laliberte, M. N. Shearer, and M. J. English.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 13-28, March, 1983. 1 Fig, 3 Tab, 16 Ref, 1 Append.

Descriptors: *Fluid flow, *Design criteria, *Energy, *Pipe size, Pipe flow, Water conveyance, Design flow, Optimization, Energy loss.

Fluid flow is analyzed through a two-stage conical diffuser used to reduce the velocity of pipe flow. An analytical approach is described for determining the optimum diameter at the interface between the first stage, a conical diffuser, and the second stage, an abrupt enlargement, such that, for given approach and exit diameters and for a given diffuser length, the energy loss coefficient is the lowest possible. Over a practical range of diameter and length ratios (ratios of exit diameter and diffuser length, respectively, to approach diameter), the analysis demonstrates that the optimal internal planar angle varies from 5 degrees 47' to 17 degrees 11' (0.101 rad-0.300 rad), and the energy loss coefficient to be applied to the approach velocity head varies from 0.01-0.25. The energy loss coefficients for the optimally designed two-stage conical diffuser are considerably less than for a single-stage diffuser and for an abrupt enlargement. Equations are presented showing the interrelationship among coefficients used variously to express energy loss in a pipe-diameter expansion as a function of approach and exit velocities. The results are presented in a form that can be used as design criteria in the fabrication of a comparison fitting for centrifugal pumps. (Murphy-IVI)
W84-04035

MEASUREMENT DEVICE EFFECT ON CHANNEL WATER LOSS,
Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
T. J. Trout.
Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 60-71, March, 1983. 7 Fig, 2 Tab, 11 Ref, 1 Append.

Descriptors: *Water loss, *Measuring instruments, Inflow-outflow analysis, Mathematical studies, Channels, Regression analysis, Head loss.

Flow measurement devices can cause significant errors in inflow-outflow channel water loss measurements. The device effects, caused by the increased water surface elevation upstream of a device, must be subtracted from measured losses to correctly estimate conveyance water loss. Methods to calculate device effects are given. In channels with small slopes and in which loss rates increase sharply with water surface increases, inflow-outflow loss measurements should be made in long channel sections with devices which create as little head loss as possible. (Author's abstract)
W84-04038

PREDICTION OF PEAK FLOWS ON SMALL WATERSHEDS IN OREGON FOR USE IN CULVERT DESIGN,
Pacific Northwest Forest and Range Experiment Station, Juneau, AK. Forestry Sciences Lab.
For primary bibliographic entry see Field 2E.
W84-04098

WASTE INJECTION: TESTING FOR MECHANICAL INTEGRITY,
Louisiana State Univ., Baton Rouge. Dept. of Petroleum Engineering.
T. C. Wilcox, and J. P. Langlinais.
Water Resources Bulletin, Vol. 20, No. 1, p 53-60, February, 1984. 7 Fig, 1 Tab, 8 Ref.

Descriptors: *Injection wells, *Underground waste disposal, *Mechanical integrity, Annular pressure, Temperature, Wastewater.

A generally accepted method to show mechanical integrity of waste injection wells is to monitor hydraulic pressure applied to the closed fluid filled annular volume (the space between the casing and tubing of an injection well). Injection pressure and waste stream temperature changes are very common, however, and these changes are reflected in annular pressure changes. Results of computer calculations are presented which predict the pressure response of a closed casing annulus of an injection well to temperature and pressure variations of the injected waste stream. The changes in injection pressure proved to be less significant than changes in the temperature of the injected fluid. Changes in injection pressure induce stress changes in the tubing and casing. The annular space undergoes a volumetric change which is reflected as a surface annular pressure change. Temperature variations of the waste stream will generate significant volumetric changes in the annular fluid which in turn results in changes in annular pressure. Graphs summarizing these results are included. Results will be of interest to waste injection well operators, inasmuch as they are required to monitor annular pressure to prove mechanical integrity of their injection wells. In view of the injection pressure and sensitive temperature effects, a constant annular pressure during routine injection operations is highly unlikely. Operators must be aware of the magnitude of these effects. (Moore-IVI)
W84-04104

8C. Hydraulic Machinery

SOLVING A SEVERE CAVITATION PROBLEM AT LA GRANDE 2,
Rousseau, Sauve, Warren, Inc., Montreal (Quebec).
D. M. Coulson, A. Demers, N. Desy, and J. G. Miron.
International Water Power and Dam Construction, Vol. 36, No. 1, p 20-24, January 1984. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Cavitation, *Turbines, *Canada, *La Grande Hydroelectric Plant, Powerplants, Hydraulic engineering, Hydraulic equipment.

A severe cavitation problem was discovered three thousand hours after the commissioning of the first unit at La Grande 2. A series of model tests was undertaken to arrive as quickly as possible at a solution. Several months of testing resulted in the conclusion that modern hydraulic turbine runners such as those supplied for LG-2 are very advanced from the points of view of power and efficiency and are more susceptible to blade entrance cavitation than less advanced runner designs. This type of cavitation is only slightly affected by the normal range of turbine setting. The experience gained at LG-2 has demonstrated that for all large projects, it is justifiable to undertake analytical and model test studies during the hydraulic design, of sufficient depth to ensure that the flow conditions in the normal operating range do not give rise to inlet edge cavitation. (Baker-IVI)
W84-03725

TRANSIENTS AND UNSTEADY PHENOMENA TO IMPROVE THE DESIGNS OF HYDROELECTRIC, PUMPED-STORAGE, AND PUMPING STATIONS,
V. Ya. Karelin, G. I. Krivchenko, N. N. Arshenevskii, and R. A. Novoderezhkin.
Hydrotechnical Construction, Vol. 17, No. 8, p 389-395, August, 1983. 4 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 8, p 8-11, August, 1983.

Descriptors: *Pumped storage, *Pumping stations, *Optimization, *Design criteria, Computers, Powerplants, Construction, Hydroelectric plants, Automation, Costs.

The problems of designing technological regimes to regulate the pumped storage units at hydroelectric stations include the selection of the optimal schemes, dimensions of the pressure conduits, parameters of the units and automatic control systems while considering all technical and economic factors, such as the reliability of operation, the required qualitative indices, and maximum cost effectiveness. One way to reduce the volume of works and capital investments in hydropower installations is to increase the response of pressure systems. Consideration of the real operating conditions and requirements is an important factor in the optimization of the designs of structures and equipment. Further developments in recommendations for optimization of the regimes of regulating units and also the introduction of numerical methods with consideration of the complete characteristics of the units with the use of computers are described. Additional improvement is needed in the computer calculation programs, particularly in optimizing the calculation methods ensuring an increase in reliability and stability of the solution. (Baker-IVI)
W84-03908

MICRO HYDRO: TURBINE SELECTION CRITERIA,
Papua New Guinea Univ. of Technology, Lae. Dept. of Mechanical Engineering.
R. J. Hothersall.
International Water Power and Dam Construction, p 26-29, February, 1984. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Pumps, *Turbines, *Decision making, *Hydroelectric plants, Mechanical equipment, Powerplants, Water resources development, Developing countries.

The term micro hydro refers to all the equipment and civil works necessary to exploit a hydropower resource of less than 100 kW. In developing countries, micro hydro often provides the only feasible energy source. A method is presented by which, for a given small hydropower resource, a suitable turbine or pump can be selected. Design features specific to small turbines are also presented. In certain applications a pump, operating in reverse as a turbine, provides an acceptable option. Data for pump selection are included. Advantages and disadvantages of impulse and reaction turbines are considered. A selection chart is offered for water turbines under 100 kW. (Baker-IVI)
W84-04075

EXPLOITING IRRIGATION SYSTEMS WITH HYDROPOWER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Mechanical, Industrial and Aerospace Engineering.
R. R. Mankbadi, S. Mikhail, and A. Baz.
International Water Power and Dam Construction, p 29-33, February, 1984. 11 Fig, 3 Ref.

Descriptors: *Turbines, *Irrigation, *Pumps, Mechanical equipment, Design criteria, Water resources development, Planning, Low head.

The turbine-pump system installed across irrigation structures in which the available low head energy is used to drive a turbine connected to a pump to lift water for irrigation or domestic purposes is examined. The equations governing the operation of the system are considered. A model is presented for determining the main design parameters of the system for a given regulator's characteristics. A method is outlined to determine the turbine's rotor and the guide blades setting such that the unit is pumping the maximum possible discharge. This procedure is applied to an example of a turbine-pump network system. The system can be designed to pump the maximum possible amount of flow at design as well as off-design conditions. The system should be considered whenever water pumping is needed for irrigation purposes or water supply and where low head hydro is available. (Baker-IVI)
W84-04076

GENERATOR DESIGN FOR SMALL HYDRO APPLICATIONS,
GEC Large Machines Ltd., Rugby (England).
F. J. Parker.
International Water Power and Dam Construction, p 55-57, February, 1984. 3 Fig.

Descriptors: *Generators, *Design criteria, Powerplants, Hydroelectric plants, Maintenance, Mechanical equipment.

Generators for small hydro schemes in the range of 500 kW to 5 MW must satisfy a number of criteria which range from the ability to withstand high overspeeds to ease of maintenance. The inertia requirements are met by the provision of a flywheel which may be located in a variety of posi-

tions. To withstand the overspeeds, the laminated components of the rotor must be of a high tensile strength material. Bearings must be able to absorb axial and radial thrusts generated by the turbine without overheating. To increase reliabiltiy, comprehensive instrumentation is supplied. (Baker-IVI)
W84-04077

AUTOMATIC HYDRAULIC GATES FOR INTAKE STRUCTURES,
Energy Engineering International, Munich (Germany, F.R.).
M. K. Jermar.
International Water Power and Dam Construction, p 57-59, February, 1984. 1 Fig, 3 Ref.

Descriptors: *Gates, *Hydraulic structures, *Hydraulic gates, Dam construction, Developing countries, Design criteria.

The automatic operation of gates for intake structures should be achieved by simple technology based on hydraulic principles only and requiring neither gearing and lifting machinery nor construction of a power supply line. A gate is suggested which consists of a hollow body with the swing axes on the weir sill. This body acts as a float balancing the weight of the gate. Its automatic operation during floods could be achieved simply by connecting a wing to the wicket. There is no danger that their resting in the upper position will cause inundation because the hydraulic pressure causes the wicket to swing downwards. The advantage is a simple construction with high structural solidity, able to be fabricated from locally available materials. Such systems are specially suitable for the conditions of remote areas in developing countries. (Baker-IVI)
W84-04078

PERFORMANCE OF STATIONARY GUN IRRIGATION SYSTEMS,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
B. W. Karney, and T. H. Podmore.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 75-87, March, 1984. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Giant gun irrigation systems, *Stationary irrigation, Application rate, Evaporation, Spray loss, Wind.

The field performance of stationary giant gun irrigation systems is evaluated from the results of 70 distribution tests conducted in the interior of British Columbia, Canada. Three measures of field performance are quantitatively evaluated including maximum application rate, evaporation and spray loss and distribution uniformity. Maximum application rate is found to be a function of average wind speed in the principal wind direction. Evaporation and spray losses were dependent on climatic and operating conditions, primarily the atmospheric vapor density deficit and the average wind speed. The uniformity of application is strongly influenced by both the gun spacing and the average wind speed. The influence of operating variables such as nozzle size and pressure are accounted for in the parameters used to nondimensionalize these relationships. The equations representing these findings are derived using multiple regression and are presented algebraically. Measured values are plotted against predicted values to give a visual impression of scatter in the data. The utility of the relationships in designing and operating giant gun systems is illustrated. (Author's abstract)
W84-04095

HYDRAULICS OF PERFORATED IRRIGATION TRAIL TUBE,
South Dakota State Univ., Brookings.
S. T. Chu.
Journal of Irrigation and Drainage Engineering, Vol. 110, No. 1, p 88-97, March, 1984. 5 Fig, 7 Ref, 2 Append.

Descriptors: *Trailing tubes, *Irrigation, *Hydraulics, Flow rate distribution, Friction loss, Pressure distribution.

Trailing tubes are perforated polyflex hoses that are connected to a traveling irrigation lateral and replace sprinklers. Trailing tube irrigation should be considered as one alternative type of center pivot irrigation because of the potential benefits in energy saving and in water use efficiency. The hydraulics of trailing tubes were investigated in order to establish guidelines to serve as a basis for design. Factors considered include tube length, total flow rate, distribution of tube flow rate, and pressure distribution. The application pattern of a trailing tube was matched to the soil infiltration characteristics represented by a two-term infiltration model. Based upon this application pattern, the flow rate distribution, the total friction loss and the pressure distribution of a trailing tube were derived. Three numerical examples were presented to illustrate the application of the theoretical results in practice. (Moore-IVI)
W84-04096

HYDRO PLANT UPGRADED FOR HIGHER OUTPUT AND REMOTE OPERATION,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 6B.
W84-04179

8D. Soil Mechanics

PREDICTING HYDRAULIC CONDUCTIVITY OF CLAY LINERS,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. E. Daniel.
Journal of Geotechnical Engineering, Vol. 110, No. 2, p 285-300, February, 1984. 7 Fig, 5 Tab, 10 Ref.

Descriptors: *Linings, *Permeability coefficient, *Clay liners, Leakage, Permeability, Soil properties, Waste disposal.

The expanding use of compacted clay for lining waste disposal pits, solid-waste landfills, and water retention ponds has provided new field experience on the performance of clay liners. In a number of instances, the liners have leaked more than anticipated. Four projects are reviewed in which rates of leakage from ponds lined with clay significantly exceeded the rates that would have been predicted on the basis of lab permeability tests. The actual hydraulic conductivities of the clay liners were generally 10-1,000 times larger than the values obtained from lab tests on either undisturbed or recompacted samples of the liners. The major problem seems to be in obtaining a representative sample of soil for testing. Field permeability tests yielded results that compared well with field performance data. In all cases involving comparatively high rates of leakage, the liners were relatively thin (less than 0.6 m thick). With only one exception, all of the liners were subjected to some dessication. Until more is known the engineer is advised to use extreme caution in extrapolating results from lab permeability tests to the field. (Baker-IVI)
W84-03724

INDUS PARADOX,
National Inst. of Oceanography, Panaji (India).
R. R. Nair.
New Scientist, Vol. 101, No. 1397, p 41-42, 16 February, 1984. 2 Fig.

Descriptors: *Rivers, *Sedimentation, *Indus River, *India, *Gulf of Kutch, Tidal barriers, Flow, Tides, Sediments, Tidal powerplants.

During a study of the flow of sediment, especially particles of mica, in the Gulf of Kutch, in the Arabian Sea, abnormal variations in the distribution of sediment were noted in the adjacent continental shelf and the Gulf of Kutch which led to the concept of dynamic barriers. The Indus River discharges 200 cu km of water annually and carries to the head of the Arabian Sea some 450 million tonnes of suspended sediment each year. Some of the sediment settles immediately giving rise to the Indus delta. The current carries another part into the deeper area of the Arabian Sea as a dense sediment suspension through the Indus Canyon. Before the sediment-laden surface water actually reaches the Saurashtra coast it comes across an unusual diversion: a tidal barrier. Fine particles pass through the barrier, but coarser ones do not. Tidal currents carry the freshwater plume into and out of the Gulf of Kutch. The Gulf of Kutch is one of two regions on the west coast of India identified as suitable for a tidal power station. A drawback to any tidal power scheme is the accumulation of sediment behind its dams, a problem that becomes acute when the source of the sediment is at the head of the bay or gulf. The Gulf of Kutch receives sediments from the open ocean, ultimately coming from the Indus River. Thus the construction of dams in this area is less likely to cause siltation. For this reason, the Gulf of Kutch will be the first choice for tidal power. (Baker-IVI)
W84-03729

MAIN DIRECTIONS IN EFFICIENT DAM CONSTRUCTION IN THE NORTH,
L. I. Kudoyarov.
Hydrotechnical Construction, Vol. 17, No. 7, p 341-346, July, 1983. 5 Fig, 8 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 6-11, July, 1983.

Descriptors: *Dam construction, *Cold weather construction, Earth dams, Freezing, Soils, Hydroelectric plants, Diaphragms.

During the construction of the Vilyui hydrostation, which is being built under harsh climatic conditions, one of the most difficult processes was the construction of the facing. To keep the soils for the facing thawed during the winter, they were stocked in large piles during the summer and covered with a layer of salted soil 2-2.5 m thick. To reduce the depth of freezing the pile was covered with a layer of foam ice 0.5 m thick, which reduced the depth of freezing to 1 m. Electrical heating was used in the winter for heating the pile. In various places and under various climatic conditions, 18 hydrostations have been constructed with dams which have metal diaphragms. The possibility of deformation of the watertight element of the dam along with its shoulders without destruction is the main criterion of reliable operation of all earth dams. A dam with a metal diaphragm fully meets this condition. The use of asphalt diaphragms is also discussed. (Baker-IVI)
W84-03765

PROVISION OF RELIABILITY OF EARTH DAMS,
V. I. Vutsel'.
Hydrotechnical Construction, Vol. 17, No. 7, p 355-358, July, 1983. 1 Fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 16-17, July, 1983.

Descriptors: *Earth dams, *Safety, Dam construction, Regulations, Hydraulic equipment, Banks, Spillways, Drains, Dam failure.

The potentially dangerous centers of failure of earth dams are located mainly in the foundation and body of the dam. For high-quality performance of all types of main works on the construction of earth and earth-rock dams, the construction sites should be equipped with machines which make it possible to place the earth materials without their segregation, to compact them to the prescribed density, to treat the compacted soil layer, and other operations. Efforts should continue to be made to develop effective methods for field control of the quality of placing earth materials. Technological designs of earth dams for regions of high seismic activity need further consideration. Requirements imposed on reliability of dams should be increased. All operating high dams and those under construction should organize effective, automatic, monitoring systems. (Baker-IVI)
W84-03766

PERFORMANCE OF GRANULAR SOIL COVERS ON CANAL LININGS,
Bureau of Reclamation, Denver, CO.
C. W. Jones.

Journal of Irrigation and Drainage Engineering, Vol. 109, No. 1, p 1-12, March, 1983. 4 Fig, 2 Tab, 5 Ref.

Descriptors: *Granular soils, *Canal linings, Erosion control, Erosion, Membranes, Linings, Particle size, Soil properties, Performance evaluation.

It is necessary for canals to have surfaces that resist water erosion and displacement by other causes. The characteristics and observed stability of fine and coarse soil cover layers placed on 16 selected canal reaches to resist water erosion and to protect asphalt, plastic membrane, and compacted earth linings are reported. The canal test locations, canal design characteristics, physical properties of the covers, and observations on the performance of the covers over periods up to 25 years are given. Based on the experience of the Bureau of Reclamation with the performance of the test reaches, a range of grading for granular covers to control erosion on canal linings with similar conditions is proposed. Soils which have generally performed well in coarse cover layers on canals with tractive forces less than 0.1 lb/sq ft (5 N/sq m) have contained: (1) Maximum particle sizes between 3 and 6 in. (75 and 150 mm); (2) less than 50 percent passing a No. 4 (4.75-mm) sieve, and less than 10 percent passing a No. 200 (75-microm) sieve. To control sloughing of cover soils, consideration should be given to the grading of fine soil beneath coarse granular layers, and where economically justified, controlling moisture and density. (Murphy-IVI)
W84-04034

CENTRIFUGE SIMULATIONS OF STABLE TAILINGS DAM,
Sandia National Labs., Albuquerque, NM.
H. J. Sutherland, and R. P. Rechard.
Journal of Geotechnical Engineering, Vol. 110, No. 3, p 390-402, March, 1984. 12 Fig, 2 Tab, 17 Ref. Bureau of Mines contract J0295038.

Descriptors: *Model studies, *Centrifuge simulations, *Tailings dams, Simulation, Phreatic surface, Dam safety, Scale models, Earth dams.

The development of the phreatic surface in a stable tailings dam is investigated by using centrifuge simulation techniques and analytical techniques. The centrifuge simulations, conducted on an 8 m radius machine, use a 'modeling-of-models' approach to determine the effects of scaling and model construction on the development of the phreatic surface. The analytical techniques are used to predict the location of the steady-state phreatic surface in the equivalent full-scale prototype dam and to determine its stability in terms of the conventional factor-of-safety. While the analysis indicates that there should by no scaling effect on the steady-state phreatic surface, the simulations show a rise in the phreatic surface with increased scaling. Numerical predications of the steady-state phreatic surface compare well with data taken below 100 g scaling. (Author's abstract)
W84-04088

8E. Rock Mechanics and Geology

EFFECT OF CHEMICAL INJECTION STABILIZATION ON GYPSUM STABILITY IN THE FOUNDATION OF HYDRAULIC STRUCTURES,
N. G. Maksimovich, and V. I. Sergeev.
Hydrotechnical Construction, Vol. 17, No. 7, p 380-384, July, 1983. 5 Fig, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 30-32, July, 1983.

Descriptors: *Gypsum, *Dam construction, *Foundations, Stability, Seepage, Dam failure, Foundation failure, Karst, Seepage.

Hydrotechnical construction in gypsum regions can create conditions for the development of a karst and threaten existing structures. The rate of dissolution of gypsum, if the seepage flow is able to dissolve it, is determined by the rate of the flow. One method to reduce the seepage flow rate is to create a grout curtain. To increase the density of grout curtains made in finely jointed gypsiferous rocks, chemical gel-forming solutions (oxaloaluminosilicate formulation) having a penetrativity close to water have recently been put into practice. Solutions containing components of the oxaloaluminosilicate formulation on interacting with gypsum not only do not dissolve it, but form on its surface compounds which are quite difficult to dissolve (calcium oxalate, and calcium hydrosilicates) which can be regarded as films protecting gypsum from dissolution. This procedure is recommended for prospective additives to clay, clay-cement, and cement grouts when stabilizing gypsiferous rocks. (Baker-IVI)
W84-03768

8F. Concrete

PREVENTING CAVITATION DAMAGE TO HYDRAULIC STRUCTURES; PART THREE,
W. S. Hamilton.
International Water Power and Dam Construction, Vol. 36, No. 1, p 42-45, January, 1984. 8 Fig, 26 Ref.

Descriptors: *Cavitation, *Air entrainment, *Spillways, Hydraulic structures, Fluid mechanics, Jets.

A simplified approach is offered to the analysis of the cavitation phenomenon with a description of the physical characteristics of cavitation and some examples of spillways where problems have been experienced. Specific attention is given to the air entrainment mechanism, entrainment from a cavity below a nappe, length of cavity, and jet creation and air supply. Specific sites discussed include Palisades dam outlet sluices, Yellowtail dam spillways tunnel, and the Ust-Ilim spillway. In areas where a concrete surface has been rather badly damaged by cavitation, a supply of entrained air may not completely stop further erosion of the damaged area but it will at least retard the erosion process. In one given example air appears to be protecting concrete in which there were already holes 30 cm or more deep. (Baker-IVI)
W84-03727

ANISOTROPY OF ELASTIC PROPERTIES OF CONCRETE WITH TABULAR GRAVEL,
I. E. Pukhov, V. V. Bobrova, and G. N. Kuleshov.
Hydrotechnical Construction, Vol. 17, No. 2, p 366-370, July, 1983. 1 Fig, 4 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 22-24, July, 1983.

Descriptors: *Dam construction, *Concrete technology, *Anisotropy, *Gravel, Construction, Concrete construction, Andizhan reservoir.

Experimental investigations were carried out at the construction site of the Andizhan reservoir to establish the presence of anisotropy of the elastic properties of mass concrete. Tests on the concrete on laboratory specimens and cores drilled from experimental blocks showed that at an early age the elastic and strength properties of the concrete with coarse tabular aggregate are anisotropic and at a late age are isotropic. This can be explained by the fact that the main source of anisotropy of the properties of concrete - air-filled voids under the coarse aggregate - gradually decrease with age of the concrete and almost completely disappear in old concrete. Such a conclusion is based on the generally known fact indicating that as the concrete ages the smallest pores and cavities in it, decreasing in volume, are filled with cement hydration products. In this case the concrete becomes more dense and homogeneous. (Baker-IVI)
W84-03767

USE OF CONCRETE FOR RETAINING WATER,
Birmingham Univ. (England). Dept. of Civil Engineering.
B. P. Hughes.
International Water Power and Dam Construction, Vol. 36, No. 3, p 18-20, March, 1984. 2 Fig, 9 Ref.

Descriptors: *Cement, *Concrete, Hydraulic structures, Dam construction, Permeability, Joints, Cracks, Temperature effects, Shrinkage.

Good quality well compacted concrete is an ideal material for retaining water because of its impermeability, availabilty and durability. The use of both mass concrete and reinforced concrete for retaining water is considered and the need for good design and practice with regard to thermal and shrinkage effects is emphasized. All concretes contract because of early thermal movement and shrinkage. Loss of watertightness because of cracking can therefore occur and must be controlled through one of several ways: use of very low cement contents and limit initial concrete temperature so that total contraction strain is insufficient to crack; limit severely cement content and initial concrete temperature and reduce external restraint to concrete to prevent cracking; limit cement contents and design reinforcement to control cracking to within design widths for estimated maximum initial concrete temperature; and design movement joints to reduce restraints and provide freedom of movement while retaining very nominal reinforcement. (Baker-IVI)
W84-04079

8G. Materials

COOLING WATER FACILITIES AT A NUCLEAR STATION,
Arizona Public Service Co., Phoenix.
For primary bibliographic entry see Field 8A.
W84-03712

STUDIES ON VINYL CHLORIDE MIGRATING INTO DRINKING WATER FROM POLYVINYL CHLORIDE PIPE AND REACTION BETWEEN VINYL CHLORIDE AND CHLORINE,
National Inst. of Hygienic Sciences, Tokyo (Japan).
For primary bibliographic entry see Field 5B.
W84-03733

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
M. H. Watt, T. J. Karikari, and A. Bunyan.
Water Resources Research Center Report No. 56, October, 1983. 207 p, 4 Fig, 13 Tab, 140 Ref, 10 Append.

Descriptors: *Training, *Water distribution, *Sewer services, *Job analysis, *Wastewater treatment, Plant operation, Maintenance, Management, Curriculum development, Need-to-know, Local organization, Washington, D.C., On-the-job training, Apprenticeship, Certification, *District of Columbia.

A long-term training program was designed for operating personnel in three bureaus (Water Services, Sewer Services, and Wastewater Treatment) within the Water Resources Management Administration (WRMA), a division of the D.C. Department of Environmental Services (DES). The project consisted of: an analysis of the agency's structure; a survey of the employees background; a survey of job and task requirements; an assessment of documentation of training needs based on workers and supervisors views; and analysis of job and performance functions; and the implementation of a pilot program aimed at providing information about the training level of workers, trainees and supervisors acceptance, selection of training methods, training facilities, and other factors relating to a long-term training program. Recommendations on a comprehensive long-term curriculum leading

to certification are provided. The report also gives guidelines for apprenticeship, certification and a comprehensive list of courses related to the training of water resources operators and technicians.
W84-03662

9B. Education (In-House)

DESIGN OF A WATER RESOURCES TRAINING PROGRAM FOR OPERATION, MAINTENANCE AND MANAGEMENT,
District of Columbia Univ., Washington. Water Resources Research Center.
For primary bibliographic entry see Field 9A.
W84-03662

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

USERS GUIDE FOR THE WATER RESOURCES DIVISION BIBLIOGRAPHIC RETRIEVAL AND REPORT GENERATION SYSTEM,
Geological Survey, Reston, VA. Water Resources Div.
N. Tamberg.
USGS Open-File Report 83-691, 1983. 114 p, 14 Fig.

Descriptors: *Documentation, *Information retrieval, Computer programs, Data storage and retrieval, Bibliographies, *Hydrologic information.

The WRDBIB Retrieval and Report-generation system has been developed by applying Multitrieve (CSD 1980, Reston) software to bibliographic data files. The WRDBIB data base includes some 9,000 records containing bibliographic citations and descriptors of WRD reports released for publication during 1968-1982. The data base is resident in the Reston Multics computer and may be accessed by registered Multics users in the field. The WRDBIB Users Guide provides detailed procedures on how to run retrieval programs using WRDBIB library files, and how to prepare custom bibliographic reports and author indexes. Users may search the WRDBIB data base on the following variable fields as described in the Data Dictionary: Authors, organizational source, title, citation, publication year, descriptors, and the WRSIC (accession) number. The Users Guide provides ample examples of program runs illustrating various retrieval and report generation aspects. Appendices include Multics access and file manipulation procedures; a 'Glossary of Selected Terms'; and a complete 'Retrieval Session' with step-by-step outlines. (USGS)
W84-03557

WATER-RESOURCES STUDIES IN UTAH BY THE U.S. GEOLOGICAL SURVEY, JULY 1, 1982, TO JUNE 30, 1983.
Geological Survey, Salt Lake City, UT. Water Resources Div.
USGS Open-File Report 83-531, July, 1983. 49 p, 3 Fig. Compiled by Hamblin, L. S.

Descriptors: Water resources studies, *Projects planning, *Utah, *Cooperative studies.

Twenty-three studies of water resources in Utah were conducted by the U.S. Geological Survey during the period July 1, 1982, through June 30, 1983. Seven of these studies were completed on June 30, 1982, or will be completed on September 30, 1983. Eighteen of these studies were in cooperation with Federal, State, county, or local agencies. Three additional studies are proposed to begin on July 1 or October 1, 1983. The 26 current and proposed projects included 7 involved mainly with collection of data, 6 concerned with the hydrology of Utah's energy-resource areas, 3 concerned with surfacewater flow, 4 on ground water in unconsolidated sediments in the basins of western Utah, and 4 concerned with ground water in consolidated rock, mostly in southeastern Utah. (USGS)
W84-03559

GERAGHTY AND MILLER'S GROUNDWATER BIBLIOGRAPHY, THIRD EDITION,
Geraghty and Miller, Inc., Syosset, NY.
F. van der Leeden.
Water Information Center, Syosset, NY, 1983. 330 p.

Descriptors: *Groundwater, *Bibliographies, Groundwater management, Groundwater protection, Groundwater contamination, Energy development, Exploration, Model studies, Legal aspects, Water quality, Groundwater flow.

This third edition of the bibliography contains over 4,500 selected references on groundwater, including both 'classic' works and significant new publications in the rapidly growing groundwater field including management, protection, contamination, exploration, energy development, modelling, and the law. The bibliography is divided into a General Section containing a listing of general bibliographies, periodicals and books followed by a Subject Section listing 29 topics. Chapters include: Exploration Techniques/Mapping and Data Collection; Geophysical Investigations; Spring/Seeps/Geothermal Resources/Heat Pump; Theory of Groundwater Flow; Tracers and Groundwater Dating; Natural Water Quality; Groundwater Contamination; Radionuclides in Groundwater/Nuclear Waste Disposal; Subsurface Disposal/Deep Well Injection; Salt-Water Intrusion; Well Design and Construction/Drilling Methods; Artificial Recharge/Wastewater Reclamation; Groundwater Models; Land Subsidence/Sinkholes/Uplift; Groundwater Law/Regulations/Legal Issues; Groundwater Management and Conservation; Education Training; and Water Witching. There are no author and subject indexes; convenient subtopics are arranged under each chapter for subjects and then listed by major author's surnames.
W84-03663

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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 11
NOVEMBER 1984

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UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

W84-04188 -- W84-04792
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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 17, NUMBER 11
NOVEMBER 1984

W84-04188 -- W84-04792

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientitsts, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

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Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

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SELECTED WATER RESOURCES ABSTRACTS

. NATURE OF WATER

A. Properties

)EPENDENCE OF RELATIONSHIP BE-'WEEN INHERENT AND APPARENT OPTI-'AL PROPERTIES OF WATER ON SOLAR AL-ITUDE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
T. O. Kirk.
Limnology and Oceanography, Vol. 20, No. 2, p 350-356, March, 1984. 4 Fig, 14 Ref.

Descriptors: *Optical properties, *Water properties, Solar radiation, Monte Carlo Techniques, Natural waters, Photons, Light penetration.

A computer simulation study using the Monte Carlo calculation procedure has been carried out to determine in what way the relationships between the apparent and the inherent optical properties of natural waters are affected by the angle of incidence of the photons on the surface. With the particular normalized volume scattering function used in these simulations, the vertical attenuation coefficient for downward irradiance at the midpoint of the euphotic zone can be expressed as a function of the absorption and scattering coefficients and the cosine of the incident photons just below the surface. As the direction of the incident light departs increasingly from the vertical, the vertical attenuation coefficient for downward irradiance at the midpoint of the euphotic zone increases but becomes progressively less responsive to increases in scattering at constant absorption. The irradiance reflectance just below the surface at all angles of incidence increases linearly with the ratio of the backscattering coefficient to the absorption coefficient. It is now clear that the angle of the incident photons on the surface materially influences the relationship between the apparent and inherent properties of natural waters. The dependence on angle of incidence fortunately takes a comparatively simple form and the expressions given here make it possible to quantitatively relate the apparent to the inherent optical properties for any solar altitude. These expressions could also be used to explore the relationships between inherent and apparent optical properties for any specific nonparallel incident light field. The incident light can be apportioned into a set of angular intervals and the equations applied to each angular flux in turn. (Baker-IVI)
W84-04393

2. WATER CYCLE

2A. General

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE STIGLER AREA, HASKELL COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, T. L. Huntzinger, J. D. Stoner, and S. P. Blumer.
USGS Water Resources-Investigations Report 82-4099, 1983. 37 p, 7 Fig, 15 Tab, 15 Ref.

Descriptors: Strip mines, Strip mine wastes, Mine drainage, Coal mines, Water quality, *Oklahoma, Stigler, Taloka Creek, Haskell County.

In the Stigler area water in bedrock, which consists of shale, siltstone, and sandstone, is under artesian conditions. Because the rocks have minimal permeability, well yields probably are less than 5 gallons per minute. Ground water is commonly a mixed cation-bicarbonate type with dissolved solids ranging from about 200 to 2,500 milligrams per liter. No relationship between water chemistry and well depth of geographic distribution is apparent. Taloka Creek had a mean dissolved-solids concentration of 72 milligrams per liter upstream of the mine area and 1,323 milligrams per liter downstream. Concentrations of some toxic metals in Taloka Creek exceeded Primary Drinking Water limits during mining, but they have not exceeded the limits since mining ceased. Potential hydrologic effects of strip mining include (1) additional water storage in strip-mine ponds, (2) changes in rock permeability and ground-water storage, (3) changes in runoff and streamflow characteristics, (4) changes in drainage patterns, and (5) changes in the chemical quality and sediment loads of streams. (USGS)
W84-04267

SNOWMELT RUNOFF AND EROSION ON IOWA LOESS SOILS,
Agricultural Research Service, Council Bluffs, IA.
R. G. Spomer, and A. T. Hjelmfelt, Jr.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1109-1111 and 1116, July-August, 1983. 4 Fig, 1 Tab, 5 Ref.

Descriptors: *Soil erosion, *Snowmelt, *Loess, *Iowa, Gully erosion, Rill erosion, Sheet erosion, Sediment yield.

If snowmelt runoff erosion is significant in western Iowa, it should be demonstrable on the loess soils at Treynor, IA. The research watersheds at Treynor have been gaged since 1964 with winter records of baseflow and runoff. Since 1967 many of the snowmelt runoff events have been sampled to provide sediment yield for field and gully erosion. Based on the 14 years of data, some snowmelt runoff can be expected every year, and it will exceed 10% of the total runoff about one out of every three years. Sheet-rill erosion resulting from snowmelt is not important in this loess soils region. Average annual sheet-rill erosion produced by snowmelt runoff was 0.3 t/ha or less and less than one percent of the average annual sheet-rill erosion. Annual gully erosion from snowmelt runoff may occasionally be of consequence. When long-term average annual values are considered, gully erosion due to snowmelt is not an important part of the average annual gully erosion. Sheet-rill and gully erosion sediment concentrations varied with time of season. Sediment concentrations were small during mid-winter snowmelt runoff events and increase with late winter snowmelt runoff. (Moore-IVI)
W84-04455

USING CROP MODELS FOR MANAGEMENT: IMPACT OF WEATHER CHARACTERISTICS ON IRRIGATION DECISIONS IN SOYBEANS,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
D. P. Swaney, J. W. Mishoe, J. W. Jones, and W. G. Boggess.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1808-1814, November-December, 1983. 4 Fig, 5 Tab, 13 Ref. USDA-ARS grant CR-806277-02-0.

Descriptors: *Crop models, *Weather patterns, *Irrigation, *Soybeans, Simulation analysis, Model studies, Economic aspects, Profit, Evapotranspiration, Crop yield, Benefits, Irrigation programs.

Crop simulation models that respond to daily weather data are being developed to assist within-season decision making. A soybean crop model was implemented to evaluate real-time irrigation decisions. The sensitivities of these decisions and of resulting profit to current season weather data, short-term weather forecasts, and assumptions about future weather were investigated for three separate seasons. The analysis indicated that actual rainfall data prior to each decision date were essential. There were increases in net profit of 2 to 3% when actual potential evapotranspiration data were used prior to each decision date instead of historical averages. The use of average temperature and radiation decreased profit by only 1 to 2%. These results suggest that savings in real-time weather data collection may be realized for practical applications of crop models for scheduling irrigations in Florida. Future weather and management conditions had a large impact on the irrigation schedules and the net profit simulated by the model. Therefore, reliable short-term precipitation forecasts coupled with location-specific precipitation probability distributions for the remainder of the season were needed for applying the soybean crop model to make real-time irrigation decisions. (Murphy-IVI)
W84-04486

GEOTHERMAL RESERVOIR SIMULATION USING NONEQUILIBRIUM THERMODYNAMICS,
Princeton Univ., NJ.
V. V. Nguyen, and G. F. Pinder.
Society of Petroleum Engineers of AIME, Vol. 23, No. 4, p 613-622, August, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Geothermal reservoirs, *Simulation, *Nonequilibrium thermodynamics, Thermodynamics, Geothermal studies, Simulation analysis, Mathematical model, Model studies, Mathematical equations, Hydrothermal flow, Hydrothermal studies.

All numerical simulators of geothermal reservoirs depend on an accurate representation of the thermodynamics of the steam/water system. An alternative view on nonequilibrium thermodynamics is presented. A phenomenological interpretation of the evolution of a steam/water system is proposed from a nonequilibrium mixture perspective. This type of thermodynamic behavior is structurally stable on the basis of catastrophe theory and therefore offers an unorthodox alternative approach to the simulation of geothermal reservoirs. Use of this approach in a one-dimensional (1D) finite-difference simulator yields results that can be compared with a traditional numerical scheme. (Murphy-IVI)
W84-04536

INTERACTIVE WATER QUALITY SIMULATION IN A REGIONAL FRAMEWORK: A MANAGEMENT ORIENTED APPROACH TO LAKE AND WATERSHED MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
K. Fedra.
Ecological Modelling, Vol. 21, No. 4, p 209-232, March, 1984. 6 Fig, 3 Tab, 20 Ref. Austrian Research Foundation grant 3905.

Descriptors: *Water quality, *Simulation, *Management planning, *Lake models, *Model studies, Hydrologic models, Computer models, Computer programs, Computers.

A phosphorus-based water quality simulation model for a shallow lake/reed system (Neusiedlersee, Austria) has been coupled with a series of heuristic, process oriented models describing the physical and socio-economic catchment of the lake. Built into an interactive, modular decision support system's framework, which includes simple database management, interactive video graphics, and linguistic output formats, the programs are designed for the simulation and evaluation of regional development, i.e, agricultural landuse, industry, tourism, wastewater treatment, and perceived lake water quality. Special emphasis is put on communication and display through a friendly man-machine interface, including linguistic statements for the description of lake water quality. (Author's abstract)
W84-04671

RESULTS OF THE UNESCO INTERNATIONAL HYDROLOGICAL PROGRAM (ERGEBNISSE DES INTERNATIONALEN HYDROLOGISCHEN PROGRAMMS DER UNESCO),
United Nations Educational, Scientific and Cultural Organization, Berlin (German D.R.). International Hydrological Programme.
S. Dyck, and P. Losel.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 95-98, March, 1983. 12 Ref.

Descriptors: *Hydrology, *East Germany, *International Hydrological Program, Water management, Research priorities.

An important part of international cooperation in hydrology consists of the German Democratic Re-

public's (GDR's) participation in two UNESCO programs: the International Hydrological Decade (IHD) from 1965 to 1974 and the International Hydrological Program (IHP). In contrast to IHD, IHP emphasizes the relationship between human activity, water resources, and the environment. At the UNESCO-sponsored International Conference on Hydrology in August 1981 in Paris, it was determined that of 67 IHP-1 (1975-80) projects, 54 were completed; some of these which proved to be of special scientific and practical value were Hydrological Parameters for Water Projects, Hydrological Aspects of Dry Spells. Changes in the Hydrological Regime as a Result of Human Activity, and Socioeconomic Aspects of Urban Hydrology. The main goal of IHP-1 was to enable individual countries to quickly solve their water problems through international cooperation in research and practice. Projects in which the GDR participated include the development and improvement of methods to calculate water balances and their elements, forecasting and simulation of drainage formation in catchment areas and of flow and transport of matter in surface waters, development and use of stochastic simulation techniques to intensify water management in river basins, management of ground water resources. The Paris conference drew up a plan for a third phase of IHP (1984-89), the theme of which will be 'Hydrology and the Scientific Principles of the Rational Management of Water Resources for Economic and Social Development.' (Gish-IVI)
W84-04782

2B. Precipitation

THE WEATHER OF '83; A YEAR OF WORLDWIDE EXTREMES, FLOODS AND DROUGHTS,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Assessment Branch.
D. LeComte.
Weatherwise, Vol. 37, No. 1, p 8-19, February, 1984. 10 Fig.

Descriptors: *Floods, *Drought, El Nino Event, Weather patterns, Rainfall, Storms, Jet stream.

The year 1983 brought extremes of weather conditions including severe droughts, heavy rains, extreme heat, and unseasonable cold - the culmination of the El Nino event. Extreme cold and the worst drought since 1936 hit the United States. The worst flooding of the century struck Ecuador, northern Peru, and large areas of Brazil, Paraguay, and Argentina. The 1982-1983 El Nino event, perhaps the greatest oceanic-atmospheric perturbation ever recorded, was justly blamed for many of the year's weather disasters. El Nino was a contributing factor to the intense north Pacific cyclonic vortex aloft which drove storms onto the North American continent. Additionally, it was probably a factor in the strong west-to-east jet stream which contributed to flooding and severe local storms affecting the United States Gulf coast states and the northwestern Caribbean in the winter and spring. (Baker-IVI)
W84-04193

SEASONAL CHANGES IN THE DISTRIBUTION OF RAINFALL OVER THE GREAT DIVIDING RANGE: GENERAL TRENDS,
Saint David's Univ. Coll., Lampeter (Wales). Dept. of Geography.
G. N. Summer.
Australian Meteorological Magazine, Vol. 31, No. 2, p 121-130, June, 1983. 5 Fig, 18 Ref.

Descriptors: *Rainfall, *Seasonal variation, *Great Dividing Range, Topographic, Rainfall area, Wind, New South Wales, Australia.

Daily rainfall linkages based on the strength of product-moment correlation coefficients are used to indicate general rainfall areas around the Great Dividing Range in New South Wales. The considerable seasonal change in the scale of rainfall occurrence associated with times of increased incidence of disturbances associated with the westerlies in the cooler half of the year and with tropical easterlies in late summer is indicated, particularly for April and May, and February respectively. Outside these times however, topographic factors emerge as important controls on the distribution of daily rainfalls. The Great Dividing Range itself is an important climatic divide in the cooler part of the year but in the summer the Hunter Valley is seen to form the center of an important rainfall area, although this feature becomes masked in February by the higher incidence of more general rainfall in that month. Further subdivisions show that combinations of certain official forecasting areas provide logical rainfall units. (Author's abstract)
W84-04280

A NEW METHOD FOR ESTIMATING THE SPATIAL DISTRIBUTION OF MEAN SEASONAL AND ANNUAL APPLIED TO THE HUNTER VALLEY, NEW SOUTH WALES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources.
M. F. Hutchinson, and R. J. Bischof.
Australian Meteorological Magazine, Vol. 31, No. 3, p 179-184, September, 1983. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Spatial distribution, *Seasonal rainfall, *Hunter Valley, *New South Wales, Empirical analysis, Rainfall, Isohyet maps, Isohyets, Model studies, Prediction.

Isohyet maps so far constructed for the Hunter Valley reflect a progression of methods, from small data sets subjectively analyzed, to more explicit methods applied to larger data sets. An empirical analysis of the spatial distribution of long-term mean seasonal and annual rainfall in the Hunter Valley for the period 1901 to 1975 is presented. Isohyet maps have been derived, using a recently developed method, from Laplacian smoothing spline surfaces fitted to rainfall data at 203 stations. The surface fitting method represents a substantial improvement over previously available subjective, least squares polynomial and weighted interpolation methods. The smoothing spline surfaces are functions of latitude, longitude and elevation with the degree of data smoothing determined by minimizing the generalized cross validation (GVC). The method does not require prior standardization of short-term means to long-term means, affords error estimates and allows testing of the validity of the fitted model. The fitted rainfall surfaces estimate long-term mean annual rainfall at any point in the valley with a percentage root mean square predictive error of 9.2% and estimate long-term mean seasonal amounts at any point with percentage root mean square predictive errors ranging from 11.9% in winter to 18.2% in summer. (Murphy-IVI)
W84-04281

NUTRIENTS IN PRECIPITATION COMPONENTS FOR PINE AND OAK FORESTS IN KUMAUN HIMALAYA,
Kumaun Univ., Naini Tal (India). Dept. of Botany.
P. C. Pathak, and J. S. Singh.
Tellus, Vol. 36B, No. 1, p 44-49, February, 1984. 6 Tab, 26 Ref.

Descriptors: *Nutrients, *Precipitation, *Pine, *Oak, *Forests, *Kumaun Himalaya, Chemistry of precipitation, Cycling nutrients, Litter, Rainfall.

Nutrients primarily move from the canopy in litterfall to the forest floor, where they are subsequently leached by percolating water and released from the organic matter by decomposition. Concentrations and inputs of certain nutrients in precipitation of pine and oak forests in Kumaun Himalaya were quantified. The mean concentration of nutrients was higher in throughfall and stemflow than in rainfall in open gauges. Among the nutrients, the leachability of K from the canopy was greatest and that of N lowest. The net gain of nutrients (kg/ha/yr) from the canopy was higher in oak forests, except for P and followed the order: K > Ca > Mg > N > P. Precipitation and throughfall inputs play a significant role in the nutrient cycling of these forests. (Murphy-IVI)
W84-04347

THE INFLUENCE OF DROUGHT ON THE FISH AND INVERTEBRATE POPULATIONS OF AN UPLAND STREAM IN WALES,
Severn-Trent Water Authority, Birmingham (England).
I. G. Cowx, W. O. Young, and J. M. Hellawell.
Freshwater Biology, Vol. 14, No. 2, p 165-177, April, 1984. 6 Fig, 3 Tab, 36 Ref.

Descriptors: *Droughts, *Invertebrates, Population dynamics, Streams, Wales, Fish, Ecosystems.

The exceptionally dry summer of 1976 presented an opportunity to assess the impact of drought on the fauna of an unregulated stream in Wales. The highest temperature was recorded during July of 1976 at Afon Dulas, recording 26.5 degrees C. The lowest temperature for the area was -1 degrees C. Diurnal fluctuations were as large as 10 degrees C. The total number of macroinvertebrates varied from 1808/sq m in September of 1976 to 7412/sq m in August of 1977. Two main effects of the drought were observed: an initial reduction in abundance during the drought and a change in community structure in the following year, probably through impaired reproduction. The only detrimental effect of the drought on the fish fauna was the elimination of the 1976 year class of young salmon, probably due to prolonged high water temperature. The trout population showed no unusual reduction in numbers as a result of the drought. (Baker-IVI)
W84-04372

STOCHASTIC SIMULATION OF DAILY RAINFALL FOR AUSTRALIAN STATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 754-759 and 766, May-June, 1983. 2 Fig, 8 Tab, 17 Ref.

Descriptors: *Rainfall, *Australia, *Stochastic process, *Simulation, Model studies.

Rainfall is an important weather variable, and it directly affects other variables such as soil moisture, maximum and minimum temperature, and evaporation. The objective of this study was to simulate daily rainfall sequences for Australia to use as inputs to weather, crop and hydrologic models. Daily rainfall data from 12 rainfall stations were selected to cover Australian rainfall conditions. Two stations were chosen from each of the six climatological zones. Four existing models were applied to generate daily rainfall data. All four models reproduced for all the stations the annual mean within the 95% confidence limits, but yielded smaller annual standard deviations than the corresponding historical values. None of the models reproduced satisfactorily the maximum daily rainfall. A model using transition probability matrices is developed to generate daily rainfall sequences for Australian conditions. The transition probability matrix method with the Box-Cox transformation for the largest state is found to be a suitable procedure to generate daily rainfall data throughout Australia. For twelve Australian stations, it preserves the daily as well as monthly and annual characteristics of the rainfall. (Moore-IVI)
W84-04437

RAINFALL CHARACTERISTICS AND THEIR RELATION TO SPLASH EROSION,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
S. W. Park, J. K. Mitchell, and G. D. Bubenzer.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 795-804, May-June, 1983. 9 Fig, 6 Tab, 23 Ref.

Descriptors: *Rain, *Rainfall intensity, *Splash erosion, Mathematical models, Terminal velocity,

Fall velocity, Drop size, Air temperature, Soil erosion.

This study involves the mathematical development of both analytical relationships for raindrop size distributions and terminal and fall velocities of raindrops. From the above relationships, storm energy and momentum parameters were simulated and then related statistically to rainfall intensity. A shifted log-normal function defines raindrop size distribution data from various regions very well. The parameters for shifted log-normal functions are closely related to rainfall intensity. The variations of the parameters with different regions appear to be very small. The number of drops contained in a rainfall is proportional to the square root of rainfall intensity. Rainfall intensity can adequately define the physical characteristics of rainfall. Terminal velocity simulated from the drag coefficient relationship was very close to the observed data. The velocity can vary significantly with ambient temperature. Fall velocity of a drop, before its terminal velocity, can be accurately determined from a buoyance and drag force relationship, and can be defined as a function of fall height and terminal velocity. Storm energy and momentum relationships were derived and expressed as a function of rainfall intensity. The values vary significantly with ambient temperature. Splash erosion rates were related to rainfall parameters and were defined as a function of rainfall momentum and number of drops. The splash erosion model can be expressed as a power function of rainfall intensity. The exponent of the model varies with soil type. (Moore-IVI)
W84-04443

A SIMPLIFIED TECHNIQUE FOR MEASURING RAINDROP SIZE AND DISTRIBUTION,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
J. D. Eigel, and I. D. Moore.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1079-1084, July-August, 1983. 8 Fig, 45 Ref. NSF grant CME8105641.

Descriptors: *Rain, *Drop size, Photography, Simulated rainfall, Distribution, Oil method.

A simple technique for measuring raindrop size and distribution is presented. This technique, the Oil Method, has the advantage of being a direct measurement technique that requires no calibration and no special equipment except a camera. The Oil Method is based on the premise that water droplets suspended in a less dense but more viscous fluid assume a near perfect spherical shape due to the surface tension forces and the pressure distribution about the drops. The collection medium is a mixture of STP oil treatment and heavy mineral oil in a 100 mm diameter, 15 mm deep disposable petri dish. The photographic method adopted is the dark-field illumination technique. The photographic images were projected onto a smooth paper screen and measured. The enlargement factor was determined from a metric scale photographed with the petri dish. Drop sizes ranging from less than 0.1 mm to over 4.75 mm have been successfully measured useing this method. The technique was found to be easy to use both in the laboratory and in the field. The Oil Method has been used to determine the characteristics of simulated and natural rainfall. (Moore-IVI)
W84-04451

PROCEDURE FOR DEVELOPING DESIGN HYETOGRAPHS FOR SMALL WATERSHEDS,
Nigeria Univ., Nsukka. Dept. of Agricultural Engineering.
G. O. Chukwuma, and G. O. Schwab.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1386-1389, September-October, 1983. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Hyetographs, *Temporal distribution, *Rainfall distribution, *Coshocton, *Ohio, Statistical methods, Sample size, Small watersheds.

A study of the time-distribution of 43 years of rainfall records for the growing season (April through September) revealed that about 40% of the storms at Coshocton, Ohio, were of type A (advanced) pattern. About 20% of the storms were of type C (intermediate) pattern. Sample-size rainfall analysis showed that variance decreased with increase in sample size. A sample of 50 storms was considered an adequate size for the storms studied. An equation derived for estimating sample size can be used to establish a representative pattern for a specified confidence interval. A statistical procedure (the bootstrap method) was followed to develop six rainfall temporal patterns of 50% probability: two advanced (types A and B), two intermediate (types C and D), and two delayed (types E and F). The procedure could be applied at other locations. The procedure for developing rainfall patterns using local data will yield results that reflect the rainfall characteristics of the location rather than a wide area of application. (Moore-IVI)
W84-04462

WINTER PRECIPITATION CATCH BY HEATED TIPPING-BUCKET GAGES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W84-04476

RAINFALL-ELEVATION RELATIONSHIPS IN THE WILSON CREEK EXPERIMENTAL WATERSHED,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
I. C. Goulter.
Canadian Journal of Civil Engineering, Vol. 11. No. 1, p 121-127, March, 1984. 5 Fig, 8 Ref.

Descriptors: *Rainfall, *Elevation, *Wilson Creek Experimental Watershed, Annual rainfall, Net rainfall, Manitoba escarpment, Rainfall variation, Topography, Upflow enhancement, Terrain analysis, Wilson Creek, Riding Mountain National Park, Manitoba, Canada.

The rainfall patterns in the Wilson Creek Experimental Watershed in Riding Mountain National park are analyzed. The rainfall-intensity-duration-frequency maps for Canada reveals that there is a significant effect on the precipitation patterns along the escarpment. Since this watershed lies on the Manitoba Escarpment there is a relatively sudden change in elevation across the watershed. The average annual rainfall is plotted against station elevation and against distance of the rainfall stations from the National Park boundary. Two distinct trends were observed. The average annual rainfall increases significantly from the bottom to the top of the escarpment. The average annual rainfall also levels off very quickly as the relatively flat plateau at the top of the escarpment is reached. No carry-over effects from terrain-induced upflow enhancement were observed. (Murphy-IVI)
W84-04552

OPTIMAL ESTIMATION OF THE AVERAGE AREAL RAINFALL AND OPTIMAL SELECTION OF RAIN GAUGE LOCATIONS,
Katholieke Univ. Leuven (Belgium). Lab. d'Automatique et d'Analyse des Systems.
G. Bastin, B. Lorent, C. Duque, and M. Gevers.
Water Resources Research, Vol. 20, No. 4, p 463-470, April, 1984. 11 Fig, 9 Tab, 10 Ref.

Descriptors: *Optimization, *Areal precipitation, *Rain gages, *Forecasting, Kriging, Mathematical equations, Rainfall intensity, Variogram model.

A simple procedure for the real-time estimation of the average rainfall over a catchment area is proposed. The estimation of such areal rainfall is an important step in many hydrological applications, such as evaluation of hydraulic balances, management of surface water resources, or real-time forecasting of river flows. The rainfall is modeled as a two-dimensional random field. The average areal rainfall is computed by a linear unbiased minimum variance estimation method (kriging) which requires knowledge of the variogram of the random field. A time-varying estimator for the variogram which takes into account the influences of both the seasonal variations and the rainfall intensity is proposed. The average areal rainfall estimator has been implemented in practice. The application to real data in two river basins in Belgium is illustrated. One of the by products of the procedure is that it yields a simple method for the selection of 'the most imformative' rain gauges among a set of existing ones, or for the selection of an optimal location to install additional rain gauges. (Murphy-IVI)
W84-04570

THE USE OF RADAR FOR HYDROLOGICAL MEASUREMENTS (MESURES HYDROLOGIQUES PAR RADAR),
Toulouse-3 Univ. (France). Lab. d'Aerologie.
H. Sauvageot.
La Houille Blanche, Vol. 5/6, p 329-340, 1983. 6 Fig, 36 Ref.

Descriptors: *Radar, *Precipitation intensity, Rain gages, Remote sensing, Hydrometeorology, Precipitation, Meteorological data collection.

Radar can be used as a quantitative hydrological sensor by interpreting meteorological echoes in terms of precipitation intensity. Promising results have been obtained from numerous tests based on this principle. The method is first presented on the basis of knowledge concerning the properties of precipitation and diffusion of the radar's electromagnetic waves by hydrometeors. Factors affecting the quality of the radar measurements are examined. A few examples of the functional relationships between the radar reflectivity factor and typical precipitation magnitudes are given. After separately examining measurement of precipitation by radar and by use of the rainfall network at ground level the author goes on to study the quality of measurements accessible to configurations which combine these two methods with a view to optimizing the accuracy of the results on the basis of the characteristics of the network and the techniques used to adjust the radar measurements with the help of data from ground level raingages. (Author's abstract)
W84-04645

THE ROLE OF DOPPLER RADAR IN THE STUDY OF PRECIPITATION (UTILITE DU RADAR DOPPLER DANS L'ETUDE DES PRECIPITATIONS),
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
P. Amayenc.
La Houille Blanche, Vol. 5/6, p 349-358, 1983. 6 Fig, 27 Ref.

Descriptors: *Doppler radar, *Precipitation, Remote sensing, Radar, Hydrometeorology, Air masses, Air-water interfaces, Meterological data collection.

During the last decade the Doppler radar has become a popular instrument for studying precipitation. The operating principle of the Doppler radar is recalled showing that, in addition to the power of the echo received, as in the case of conventional radar, it also can measure the radial velocity of cones in each field observed. The three conventional methods of using the Doppler radar for scientific purposes are then obtained. For each method, the principle together with recent modifications is described and physical quantities obtainable are illustrated by significant experimental results. The methodology of vertical shooting is examined whereby data on the vertical air speed and granulation of precipitation at the radar zenith can be recorded. Described are the conical speed method with one radar and the use of networks with two or more radars. The latter make it possible to observe the three-dimensional dynamics of air movement within a given precipitation system. Briefly indicated are recent operational applications based on rapid recognition of typical signals in reflectivity and radial velocity pictures which are provided with numbers and displayed on a color screen. They are basically used for short-term forecasting of violent and dangerous phenom-

ena (severity of near thunderstorms, tornadoes, gust fronts, turbulent zones). Two possible future developments expected over the next few years are also mentioned: the rapid sweep Doppler radar and the Airborne Doppler radar. (Murphy-IVI)
W84-04646

THE USE OF RADAR FOR FLOOD WARNING AND FORECASTING IN THE CRITICAL BASINS OF THE VEZERE AND CORREZE (LE RADAR ET LA PLUIE. APPLICATION A L'ANNOUNCE ET A LA PREVISION DES CRUES DANS LES BASSINS CRITIQUES DE LA VEZERE ET DE LA CORREZE),
Service Hydrologique Centralisateur du Bassin de la Garonne, Toulouse (France).
J.-P. Dupouyet.
La Houille Blanche, Vol. 5/6, p 387-392, 1983. 8 Fig.

Descriptors: *Radar, *Flood forecasting, *Vezere basin, *Correze basin, Flood plain management, Flood data, Flood profiles, Remote sensing, Precipitation intensity, Precipitation, Depth-area-duration analysis, Meteorological data collection, Hydrometeorology.

In order to alleviate the effects of rapid flooding of the Vezere and its tributary, the Correze, and to reduce the warning delay for the local population, the Central hydrological office for the Dordogne basin has used radars to test several methods whereby a relationship can be established between rain-gauge recordings and corresponding radar echoes. The experimental approach adopted appears suitable for forecasting rainfall and it is feasible for meteorological radars to effectively complete a conventional rain-gauge network. (Author's abstract)
W84-04647

THE USE OF RADAR AS AN AID TO QUANTITATIVE ESTIMATION OF PRECIPITATION. FORECASTING SUDDEN FLOODS IN MARTINIQUE (LE RADAR COMME AIDE A L'ESTIMATION QUANTITATIVE DES PRECIPITATIONS. PREVISION DES CRUES ECLAIRS EN MARTINIQUE),
Service Meteorologique Metropolitain, Le Bourget (France).
M. Le Quentrec.
La Houille Blanche, Vol. 5/6, p 393-398, 1983. 5 Fig.

Descriptors: *Radar, *Precipitation, *Flood forecasting, Flood data, Meteorological data collection, Hydrometeorology, Remote sensing, Telemetry, Martinique.

Joint use of radar telemetered rain-gauges and the conventional methods of a meteorological center which offers the advantage of working round the clock and being equipped with rapid warning systems has been tested with encouraging results on a basis of less than 100 sq km where reaction time is only a few hours. (Author's abstract)
W84-04648

CALIBRATION OF A METEOROLOGICAL RADAR FOR MEASURING PRECIPITATION. INITIAL RESULTS IN THE PARIS REGION (CALIBRATION D'UN RADAR METEOROLOGIQUE POUR LA MESURE DES PRECIPITATIONS. PREMIERS RESULTATS EN REGION PARISIENNE),
Centre National de la Recherche Scientifique, Marseille (France). Inst. de Mecanique des Fluides de Marseille.
J. D. Creutin, G. Delrieu, and Ch. Obled.
La Houille Blanche, Vol. 5/6, p 421-429, 1983. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Radar, *Calibrations, *Precipitation intensity, *Paris, Comparison studies, Meteorological data collection, Hydrometeorology, Rain gages, Rainfall intensity, Remote sensing, France.

Quantitative estimation of precipitation using meteorological radar is of interest to hydrologists. The hourly and daily data were used from the Dammartinen-Goele radar and a recording rain-gage network to present an initial approach to the problems of radar compared with an interpolation technique (Spline) which uses recording-gage networks only. Hourly comparisons taken at random (53 stations) between radar hyetographs and rain-gage recordings have made it possible to highlight several problems encountered in radar measurement (the importance of the Z-R (Marshall-Palmer) relationship, ground echoes, masking effects, distance effects on the radar, uniform calibration procedures) and to derive criteria concerning the choice of a minimum, representative calibration network. Initial tests were conducted to validate random radar measurement (with uniform, regionalized calibration by a sub-network (64 stations) with three days of uninterrupted operation of the radar and a dense network of rain-gages (270)). For these three days only the regionalized calibration technique gave results equivalent to those from a conventional (Spline) interpolation method using the calibration sub-network only. Only systematization of the calibration and validation procedures described to other rain spells and for a more extensive network of recording rain-gages can lead to definite conclusions. (Murphy-IVI)
W84-04649

2C. Snow, Ice, and Frost

JAKOBSHAVNS GLACIER DRAINAGE BASIN: A BALANCE ASSESSMENT,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
R. A. Bindschadler.
Journal of Geophysical Research, Vol. 89, No. C2, p 2066-2072, March 10, 1984. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Jakobshavns Glacier, *Catchment areas, Glaciers, Glaciohydrology, Glaciology, Glacial drift, Glacier balance, Glacier surges, Greenland.

Maximum and minimum estimates are made of the drainage basin feeding the Jakobshavns Glacier by using surface elevation maps derived from Seasat altimetry. Benson's (1962) net balance measurements are used to calculate the balance flow within the basin. Comparisons of the balance flux at the terminus with estimates of actual flux suggest the basin is in overall equilibrium or slightly thickening. This agrees with measurements along the nearby EGIG traverse. Balance velocities accelerate rapidly within 100 km of the coast. Further upstream, balance velocities are consistent with both measured velocities along the EGIG traverse and calculated deformation velocities. It is estimated that Jakobshavns Glacier discharges between 4.8 and 7.6% of the annual net balance over Greenland and drains between 3.7 and 5.8% of the ice sheet area. (Author's abstract)
W84-04297

SPRING BREAKUP AND FLUSHING OF AN ARCTIC LAGOON ESTUARY,
Alaska Univ., Fairbanks. Geophysical Inst.
J. B. Matthews, and W. J. Stringer.
Journal of Geophysical Research, Vol. 89, No. C2, p 2073-2079, March 20, 1984. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Ice breakup, *Arctic lagoon, *Estuaries, Snowmelt, Floodwaters, Satellite technology, Flushing, Salinity, Saline-freshwater interfaces, Simpson Lagoon, Beaufort Sea, Kuparuk River, Egg Island Channel.

Simpson Lagoon is a shallow body of water separated from the Beaufort Sea by a chain of low-lying barrier islands. Narrow channels are found between the barrier islands, one of which, the Egg Island Channel, is a major connection between the lagoon and the Beaufort Sea. The Kuparuk River produces great quantities of springtime floodwaters which overflow the still-frozen lagoon. This paper examines the relationships between these floodwaters and the character of the water within the lagoon. Measurements of temperature, salinity, sea level, and currents have been made in Egg Island Channel during 1978 and 1979. Meltwater from the Kuparuk River was observed on satellite images to overflow the 2-m-thick bottomfast ice of the lagoon in late May and early June. These floodwaters flush saline (greater than 40%) water out the 5-m deep channel and replace it with freshwater at 0 degrees C. Analysis of satellite images for several years shows that overflow occurs on May 31 with a standard deviation of 8 days. Sea level rose 64 cm above mean at peak flood in 1978. Subsequently, channel waters warmed to 8 degrees C in late June and were flushed by cold (approximately 0 degrees C), saline (approximately 24%) water from the Beaufort Sea in mid-July. Flooding in 1979 was anomalously early, providing additional insight into the flushing process. The return of seawater to the channel is due to wind-driven currents following the clearing of bottomfast ice in the lagoon. Satellite image analysis shows that ice-free conditions occur by July 10 with a standard deviation of 8 days. (Author's abstract)
W84-04298

ENVIRONMENTAL ISOTOPE CONTENT, GEOCHEMISTRY AND GENESIS OF ICE LENSES (PALSEN) IN NEW QUEBEC PEAT BOGS (CANADA) (COMPOSITION ISOTOPIQUE, GEOCHIMIE ET GENESE DE LA GLACE EN LENTILLES (PALSEN) DANS LES TOURBIERES AU NOUVEAU QUEBEC (CANADA)),
Paris-11 Univ., Orsay (France). Lab. d'Hydrologie et de Geochemie Isotopique.
L. Dever, C. Hillaire-Marcel, and J. Ch. Fontes.
Journal of Hydrology, Vol. 71, No. 1-2, p 107-130, March 15, 1984. 11 Fig, 5 Tab, 35 Ref.

Descriptors: *Sedimentation, *Geochemistry, *Isotropy, *Ice lenses, *Peat bogs, *Quebec, *Canada, Hudson Bay Ground ice, Ice formation, Dendrochronology.

Sedimentological, geochemical and isotopic (O-18, H-2, H-3) data for samples cored in peat bogs from eastern Hudson Bay profiles were established on four palsen. Cored profiles varies from 5 to 8 m; their summit culminates 2-3 m above the drainage level of the peat bog. The peat bog began to develop ca. 3650 + or - 100 B.P. on top of Tyrell sea clays. The ice content varies from 10% to 100% and averages at 50% in most of the profiles. Tritium contents as high as 200 T.U. are occasionally observed. They indicate inputs of recent meteoric waters. O-18 contents (ca. - 14.5 0/00 vs. SMOW) are in agreement with this interpretation inasmuch as they reflect the freezing (with approximately 3 0/00 enrichment in O-18) of the last 20 years' precipitation (mean annual temperature approximately equal to 4 degrees C). Abnormally high H-2 excesses (up to 77% above the usual relationship d = delta(H-2)-8deltaO-18) characterize some ice layers. They are interpreted as an effect of partial changes in phase (solid-liquid-vapor) of water, especially within the snow cover and further transfer of residual vapor through discontinuous ice profiles. Dendrochronological controls indicate a recent growth of ice lenses ca. 1850-1870 A.D. These lenses decayed during the first half of the 20th century, then they increased again since the 1950 thermal optimum. (Author's abstract)
W84-04303

ESTIMATION OF THE MASS OF LARGE SNOW AVALANCHES,
National Research Council of Canada, Vancouver (British Columbia). Div. of Building Research.
P. A. Schaerer, and B. B. Fitzharris.
Canadian Journal of Civil Engineering, Vol. 11, No. 1, p 74-81, March, 1984. 4 Fig, 3 Tab, 11 Ref.

Descriptors: *Avalanches, *Mass, Snow accumulation, Snow cover, Snow depth, Mathematical equation, Model studies, Prediction, Frequency, Design, Water equivalent, Rogers Pass, Canada.

When roads, railways, ski lifts, buildings, powerlines, or bridges are planned in areas exposed to snow avalanches, questions arise about maximums to be expected and how frequently they will occur. Estimating the size and return period of a design avalanche is somewhat similar to predicting the

magnitude and frequency of floods. The mass of avalanches was investigated using two series of observations made at Rogers Pass in Western Canada. Large avalanches occur once in 3-25 years at each avalanche path, and their mass greatly exceeds that of annual maximum avalanches. Standard extreme-value frequency distributions cannot be applied. An empirical predictive equation for the mass of large avalanches is presented that takes into account the 30-year maximum water equivalent of the snow in the avalanche path, surface area of the catchment, and incline of the starting zone. Observed avalanches with an apparent return interval of 100 years or greater had masses close to the predicted values. (Murphy-IVI)
W84-04551

INSOLATION TOPOCLIMATES AND POTENTIAL ABLATION IN ALPINE SNOW ACCUMULATION BASINS: FRONT RANGE, COLORADO,
Indiana Univ. at Bloomington. Dept. of Geology.
G. A. Olyphant.
Water Resources Research, Vol. 20, No. 4, p 491-498, April, 1984. 6 Fig, 4 Tab, 31 Ref.

Descriptors: *Insolation, *Topoclimates, *Ablation, *Snow accumulation basins, *Front Range, *Colorado, Topography, Snowmelt, Snow accumulation, Climates, Climatic data, Alpine regions, Cloud cover.

Cirques are a fundamental hydrologic unit in alpine areas because they constitute the primary snow accumulation area above the timberline. Measurements of insolation during the Indian Peaks snowmelt season indicate that the average diurnal trajectory of solar transmission is highly asymmetric with lower values occurring in the afternoon when cloud coverage is maximum. A statistical analysis of simulated insolation suggests that topographic factors interact with prevailing sky conditions to produce a complex pattern of topoclimates within the study area. Differences between insolation topoclimates are not stationary; they depend upon timing and degree of cloud coverage as reflected in the diurnal trends of solar transmissions. On an average summer day (clear morning-cloudy afternoon), simulated insolation to north and south facing basins is roughly equivalent, while east facing basins receive the largest daily totals. These findings are important to snow hydrologists because relative (intramountain) differences in glacier ablation, and therefore potential basin melt, appear to be adjusted to the pattern of radiation that occurs on partly cloudy (not cloudless) days. (Murphy-IVI)
W84-04573

2D. Evaporation and Transpiration

TURFGRASS EVAPOTRANSPIRATION. II. RESPONSES TO DEFICIT IRRIGATION,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
C. M. Feldhake, R. E. Danielson, and J. D. Butler.
Agronomy Journal, Vol. 76, No. 1, p 85-89, January-February, 1984. 8 Fig, 6 Ref.

Descriptors: *Irrigation practices, *Water use, Conservation, Water conservation, Canopy, Lysimeters, Nitrogen, Turfgrass, Arid regions.

In the arid west, deficit irrigation has contributed significantly to efficient use of water resources. The effect of deficit irrigation on turfgrass quality was studied using small lysimeters where root systems were confined and evapotranspiration was limited to the amount of irrigation. In most cases there was a sharp change in slope of the quality vs evapotranspiration (ET) relationship for turfgrass. Kentucky bluegrass decreased about 10% in quality with an irrigation schedule providing up to a 27% ET deficit. Larger deficits resulted in greater relative decreases in quality. When ET was maintained at greater than 30% deficits, the quality rating of Kentucky bluegrass was lower if mowed at 2 cm than when mowed at 5 cm. When N fertility was low, maximum ET and maximum quality were decreased, but the response of quality to irrigation deficits greater than 27% was similar. The response of tall fescue to deficit irrigation was similar to that of Kentucky bluegrass. Buffalograss, however, responded with notable differences. Decreasing ET also had an effect on microclimate. Turfgrass canopy temperature increased 1.7 degrees C for each 10% decrease in irrigation up to 70% decrease suggesting that, during summer months, if irrigation is limited, the effect on urban climate may become a concern. (Baker-IVI)
W84-04418

BASINWIDE WATER REQUIREMENT ESTIMATION IN SOUTHERN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, L. H. Allen, Jr., L. C. Hammond, J. W. Jones, and J. S. Rogers.
Transaction of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 760-766, May-June, 1983. 6 Tab, 22 Ref.

Descriptors: *Florida, *Evapotranspiration, *Water requirements, *Everglades, Irrigation requirements, Effective precipitation, Water allocation.

Penman, pan evaporation, Thornthwaite, Blaney-Criddle, and water budget methods were used to estimate basinwide monthly evapotranspiration (ET) in the Everglades Agricultural Area (EAA). The Penman method gave predictions closest to monthly basinwide water budgets and the Thornthwaite method had the largest deviations. The modified Blaney-Criddle method ranked a close second, the pan evaporation method a close third, and the Blaney-Criddle method a distant fourth. From the standpoint of data availability and ease of use, the pan evaporation and modified Blaney-Criddle methods could be used to estimate basinwide monthly water allocation because those two methods predict irrigation requirement near that estimated by the Penman method and the water budget. The total effective rainfall of approximately 800 mm is common to all methods except the Thornthwaite method which predicted 918 mm. The Soil Conservation Service method for estimating monthly effective rainfall was observed to be a satisfactory approach for the organic soil watershed of the EAA. (Moore-IVI)
W84-04438

RICE YIELD, BIOMASS, AND LEAF AREA RELATED TO EVAPOTRANSPIRATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih, G. S. Rahi, G. H. Snyder, D. S. Harrison, and A. G. Smajstrla.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1458-1464, September-October, 1983. 5 Fig, 3 Tab, 11 Ref. South Florida Water Management District grant 4-FCD-22.

Descriptors: *Evapotranspiration, *Crop yield, *Rice, *Everglades, *Florida, Growth stage, Water management, Biomass, Leaf area index, Seasonal variation.

Rice is being considered as an alternative crop for the Everglades Agricultural Area to reduce subsidence and preserve the organic soil, because it grows well under flooded conditions. In order to cope with the water-resource problem caused by the uneven rainfall distribution in Florida, rice evapotranspiration (ET) must to be investigated to determine whether ET would vary with growth stage. Studies on the relationships among ET, grain yield, dry biomass, and leaf area index (LAI) of rice were conducted in lysimeters and in the field. Two methods of planting rice were used: transplanting and direct seeding. There were twelve planting combinations involving spring, summer, and fall crops. Three equations involving linear leaf measurements and stem lengths were developed to estimate the LAI. Peak ET rates occurred during the reproductive stage and coincided well with the maximum LAI value. Two equations involving dry biomass and grain yield in relation to ET were also developed. The relationship between dry biomass (DB) and ET was found to be: DB = 4715.2 + 303.1 ET. Grain yield (rough rice at 12% moisture, GY) was related to ET as: GY = 3995.8 + 174.9 ET. With an average rice yield in the Everglades of Florida, the total ET requirement would be about 54 cm. Planting dates may have to be adjusted to avoid the peak water demand coinciding with the dry season in the Everglades. (Moore-IVI)
W84-04473

EVAPOTRANSPIRATION FROM A HUMID-REGION DEVELOPING CITRUS GROVE WITH GRASS COVER,
Florida Univ., Gainesville.
J. S. Rogers, L. H. Allen, Jr., and D. V. Calvert.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1778-1783 and 1792, November-December, 1983. 2 Fig, 10 Tab, 25 Ref.

Descriptors: *Evapotranspiration, *Citrus fruits, *Irrigation demand, *Florida, Grass, Hydrologic budget, Soil water, Mathematical equations, Humid areas.

The planning of irrigation water supplies and the design and operation of irrigation systems require reliable evapotranspiration (ET) data, but long-term data on water used by crops in humid regions are limited. The ET of a developing citrus grove in a humid climate in the South Florida Flatwoods Land Resource Area was determined by water balance from measured rainfall, irrigation, subsurface drainage, surface runoff, and the change in soil moisture storage. The change in soil moisture storage was estimated from soil moisture characteristic curves and measured water table elevations. Annual ET ranges from 820 to 1280 mm and averaged 1090 mm across all treatments. When soil moisture was not seriously limited the annual ET averaged 1210 mm. Linear regression of ET vs time indicated a significant increase of 13% in ET over the 8 years of the study. This increase was attributed to increasing tree size since the grass understory was maintained to provide similar cover conditions throughout the study. Daily ET rate, averaged by months, ranged from 1.5 mm in January to 5.0 mm in June. Four predictive equations for ET gave good estimates of measured values, but require crop coefficients that are slightly modified from previously published values. Since a vegetation-free understory is unlikely to be practical for high water table, humid region, citrus groves, the ET data and monthly crop coefficients should be valid over a wide range of tree sizes. (Moore-IVI)
W84-04485

EVAPORATION FROM FLOWING CHANNELS,
Geological Survey, Atlanta, GA.
J. M. Fulford, and T. W. Sturm.
Journal of Energy Engineering, Vol. 110, No. 1, p 1-9, March 1984. 8 Fig, 1 Tab, 8 Ref.

Descriptors: *Evaporation, *Channels, *Mass transfer, Mathematical studies, Heat budget, Wind,.

Prediction of evaporation is an important part of engineering evaluations of water quality and quantity. Evaporation affects thermal water quality because of the surface heat flux associated with it. In arid climates, evaporation losses in water budget calculations can be an important factor in water quantity determinations. Stability-dependent and Dalton-type mass transfer formulas determined from experimental evaporation data in ambient and heated channels have similar performance in prediction of evaporation. The formulas developed are compared with those proposed by others for lakes and flowing channels. Neither a Dalton-type nor a stability-dependent formula for the wind function was clearly superior for determining evaporation from flowing channels. For the heated channel, however, the constant in the Dalton-type formula was explained well by the formulation of the free-convection term in the stability-dependent formula. This suggests that the stability-dependent formula may be more appropriate for heated chan-

nels in which a large variation in the free-convection transport term is expected. Further studies of the evaporation from flowing channels, in which the effects of wind fetch and shielding can be more accurately determined are needed. (Baker-IVI)
W84-04491

TRANSFER OF MASS AND ENERGY IN A CASSAVE (MANIHOT ESCULENTA CRANTZ VS. CUBANA) COMMUNITY 1. MICROCLIMATE AND WATER VAPOUR EXCHANGE IN A SAVANNA CLIMATE,
Instituto Venezolano de Investigaciones Cientificas, Caracas.
J. J. San Jose, and F. Berrade.
Annals of Botany, Vol. 52, No. 4, p 507-520, October, 1983. 8 Fig, 2 Tab, 33 Ref.

Descriptors: *Cassava, *Microclimate, *Water vapor, *Savanna climate, Energy balance, Climates, Water requirements, Humidity, Canopy, Soil-water-plant relationships.

The energy balance approach was used to evaluate the transfer processes which occur between a cassava community, growing during a savanna wet season, and its environment. Crop performance under these conditions was also analyzed. During this season, the soil profile remained near saturation, hence net radiation absorbed by the cassava crop during typical low radiation days, was mainly dissipated as latent heat (78-86%); a process which depends on the growth stage and on the foliage cover of the canopy. However, the seasonal root environment, with a sufficient water supply, contrasted with the extremely variable shoot environment, because the daily flux density of short wave radiation input reached values similar to those reported for typical dry season days. On these days, cassava responded to environmental stress mainly by a reduction in transpiration. At the end of the wet season soil water content markedly decreased, an additional stress factor on the roots, which produced a notable reduction of cassava leaf area index. Therefore, the moderate changes in energy partitioning determined by morphological and physiological adaptive responses of cassava, produce a hindrance in the equilibrium between water vapor transfer and the surrounding savanna environment. (Author's abstract)
W84-04531

EFFECTS OF WIND VELOCITY ON STOMATAL CONDUCTANCE AND CONSEQUENCES OF LEAF ROLLING ON WATER UPTAKE IN TALL FESCUE,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium).
For primary bibliographic entry see Field 2I.
W84-04774

2E. Streamflow and Runoff

TECHNIQUE FOR ESTIMATING DEPTH OF FLOODS IN TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
C. R. Gamble.
USGS Open-File Report 83-4050, 1983. 21 p, 6 Fig, 2 Tab, 5 Ref.

Descriptors: *Floods, *Flood plains, *Regression analysis, Flood plain management, Hydrologic data, *Flood depth, Flood-prone area mapping, *Tennessee.

Estimates of flood depths are needed for design of roadways across flood plains and for other types of construction along streams. Equations for estimating flood depths in Tennessee were derived using data for 150 gaging stations. The equations are based on drainage basin size and can be used to estimate depths of the 10-year and 100-year floods for four hydrologic areas. A method also was developed for estimating depth of floods having recurrence intervals between 10 and 100 years. Standard errors range from 22 to 30 percent for the 10-year depth equations and from 23 to 30 percent for the 100-year depth equations. (USGS)
W84-04242

MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN SOUTHEASTERN MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
R. J. Omang, C. Parrett, and J. A. Hull.
USGS Water-Resources Investigations Report 82-4092, April, 1983. 33 p, 19 Fig, 5 Tab, 28 Ref.

Descriptors: *Annual runoff, Regression analysis, *Estimating equations, Ephemeral streams, Perennial streams, Gaging stations, Crest gage, Streamflow, Active-channel width, Bankfull width, Channel geometry, *Montana, Basin characteristics, *Peak flow.

Equations using channel-geometry measurements were developed for estimating mean runoff and peak flows of ungaged streams in southeastern Montana. Two separate sets of esitmating equations were developed for determining mean annual runoff: one for perennial streams and one for ephemeral and intermittent streams. Data from 29 gaged sites on perennial streams and 21 gaged sites on ephemeral and intermittent streams were used in these analyses. Data from 78 gaged sites were used in the peak-flow analyses. Southeastern Montana was divided into three regions and separate multiple-regression equations for each region were developed that relate channel dimensions to peak discharge having recurrence intervals of 2, 5, 10, 25, 50, and 100 years. Channel-geometery relations were developed using measurements of the active-channel width and bankfull width. Active-channel width and bankfull width were the most significant channel features for estimating mean annual runoff for al types of streams. Use of this method requires that onsite measurements be made of channel width. The standard error of estimate for predicting mean annual runoff ranged from about 38 to 79 percent. The standard error of estimate relating active-channel width or bankfull width to peak flow ranged from about 37 to 115 percent. (USGS)
W84-04270

SPRING BREAKUP AND FLUSHING OF AN ARCTIC LAGOON ESTUARY,
Alaska Univ., Fairbanks. Geophysical Inst.
For primary bibliographic entry see Field 2C.
W84-04298

ESTIMATION OF LOG-NORMAL QUANTILES: MONTE CARLO RESULTS AND FIRST-ORDER APPROXIMATIONS,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
K. Hoshi, J. R. Stedinger, and S. J. Burges.
Journal of Hydrology, Vol. 71, No. 1-2, p 1-30, March 15, 1984. 1 Fig, 14 Tab, 51 Ref. NSF grant CME8010889.

Descriptors: *Log-normal quantiles, *Monte Carlo method, *Mathematical models, Flood frequency, Three-parameter log-normal distribution, Flood flow.

The three-parameter log-normal (LN3) distribution is often used to describe hydrologic data, particularly for synthetic streamflow generation and for flood frequency analysis. Monte Carlo estimates of the average bias and root mean square error achieved with different quantile estimation procedures for the three-parameter log-normal distribution allow a comparison of the method's performance. The maximum likelihood method, method of moments, and two quantile-lower-bound estimators in combination with two moments in real or in log space were considered. The maximum likelihood method and Stedinger's quantile-lower-bound methods provide more accurate estimators of the 1 and 10 percentiles of the distribution. No method was best for estimating the 99 and 99.8 percentiles. First-order approximations provide reasonable estimates of the estimators' sampling variance in most cases. All quantile estimators of the 99 or 99.8 percentiles of a flood-flow distribution were shown to yield design flood values which will be exceeded with probabilities substantially in excess of 1% and 0.2%, respectively. (Murphy-IVI)
W84-04299

SOME ASPECTS OF RIVER FLOW IN NORTHERN NEW SOUTH WALES, AUSTRALIA,
Hull Univ. (England). Dept. of Geography.
R. C. Ward.
Journal of Hydrology, Vol. 71, No. 1-2, p 31-51, March 15, 1984. 12 Fig, 2 Tab, 9 Ref.

Descriptors: *River flow, *New South Wales, *Australia, Streamflow, *Great Divide, Average flow, Flood flow, Flow duration, Precipitation, Runoff, Rainfall-runoff relationships.

A number of catchment and hydrological characteristics are examined for a 385,000 sq km study area in northern New South Wales. This study area spans the Great Divide and data selected from the archives of the New South Wales Water Resources Commission illustrate the marked contrasts in the character and viability of streamflow between coastal rivers draining comparatively small steeply sloping basins east of the Great Divide and the larger river systems draining the more extensive semi-arid basins of the western slopes. Particular attention is paid to comparisons of annual flows, flow-duration curves, seasonal flow regimes, flood flow and low flows. The study not only confirms the hydrological contrasts between two distinct geographical regions but also emphasizes the rigorous data requirements of hydrological studies in areas of high variability of precipitation and streamflow. (Author's abstract)
W84-04300

THE GENERATION OF STORM RUNOFF IN A FORESTED CLAYEY DRAINAGE BASIN IN LUXEMBOURG,
James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Geography.
M. Bonell, M. R. Hendriks, A. C. Imeson, and L. Hazelhoff.
Journal of Hydrology, Vol. 71, No. 1-2, p 53-77, March 15, 1984. 7 Fig, 3 Tab, 78 Ref.

Descriptors: *Storm runoff, *Catchment areas, *Luxembourg, Clayey soils, Rainfall-runoff relationships, Hydrographs, Soil horizons.

The clayey soils on the gently sloping forested Keuper formations of Luxembourg are characterized by a microtopography of shallow depressions and ridges. During rainfall in the winter months, when a seasonal water table develops above the almost impermeable B horizon, the depressions and the slopes draining to them generate storm runoff. Storm-runoff generation in one of these depressions, in the Schrondweilerbaach drainage basin near Ettelbruck, was investigated between November 1979 and January 1983. Runoff leaving the drainage basin was examined with respect to water-table elevations and soil conditions. This included investigating the relationship between the recession characteristics of the well and plot-runoff hydrographs and the soil profile. Of particular importance for runoff generation is the high degree of biological activity in the nutrient-rich soils and the resulting high macroporosity of the A11 horizon. It appears that storm runoff is produced when the water table rises above the base of the A12 horizon in the A11 horizon. On all slopes, on about eight occasions each year, rainfall amounts and intensities are sufficient to raise the water table to a position at or within a few centimeters of the surface, and saturation overland flow occurs. This overland flow travels at lower velocities than water moving in the narrow tunnels and animal burrows in the A11 horizons, from which it is difficult to distinguish. Overland flow was recorded when the maximum 30-min. rainfall during a storm exceeded 1.5 mm. Soil properties controlling the rainfall-runoff relationship are dynamic and related to the forest and soil ecology. For this reason it is not possible to extrapolate the conditions described in this paper to ecologically different areas. (Author's abstract)
W84-04301

AN EVALUATION OF THE PERFORMANCE OF A FINITE DIFFERENCE APPROXIMA-

trickle discharges. The simulated wetting patterns indicated closer agreement with published experimental data than did alternative models, especially under high rates of trickle discharge. (Murphy-IVI)
W84-04346

SOME EXACT SOLUTIONS FOR SOLUTE TRANSPORT THROUGH SOILS CONTAINING LARGE CYLINDRICAL MACROPORES,
Agricultural Research Service, Riverside, CA. Salinity Lab.
M. T. van Genuchten, D. H. Tang, and R. Guennelon.
Water Resources Research, Vol. 20, No. 3, p 335-346, March, 1984. 3 Fig, 41 Ref.

Descriptors: *Solute transport, *Soil water, *Macropores, Mathematical equations, Diffusion, Soil matrix, Soil pores.

Large macropores can significantly influence the rate of water and solute movement in field soils, especially during conditions near saturation. Several exact and approximate analytical solutions are presented for equations describing convective-dispersive solute transport through large cylindrical macropores with simultaneous radial diffusion from the larger pores into the surrounding soil matrix. Adsorption effects were included through the introduction of linear isotherms for both the macropore region and the soil bulk matrix. In one formulation the macropores are surrounded by cylindrical soil mantles of finite thickness. Another formulation considers diffusion from a single cylindrical macropore into a radially infinite soil system. Approximate solutions are presented for the radial concentrations distribution within the adjacent soil matrix. At early times, little accuracy is lost when the radially finite soil mantle is replaced by an infinite system. For at least one set of system parameters, a simple approximation solution for the concentration in the macropore liquid phase was found to give an excellent approximation of the more complicated exact solution. This approximate solution ignores dispersion in the macropore system and also assumes that the soil matrix surrounding the macropore extends to infinity. (Moore-IVI)
W84-04358

ANALYSIS OF SOIL EXTRACTS FOR INORGANIC AND ORGANIC TRACER ANIONS VIA HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
R. S. Bowman.
Journal of Chromatography, Vol. 185, No. 3, p 467-477, March, 1984. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Tracers, *Chromatography, Soil water, Environmental tracers, Anions, Organic soils.

A high performance liquid chromatographic technique allowing simultaneous quantification of Br(-), SCN(-), I(-), and four fluorinated benzoic acid derivations in soil extracts is described. The method requires a minimal amount of sample preparation and should be suitable for analysis of other anions of interest in natural waters. Detection limits for tracer standards were in the range of 1.2 to 3.5 ng. A chromatogram for a typical tracer containing soil extract is presented. (Baker-IVI)
W84-04381

SUBSURFACE DRAINAGE EFFECTIVENESS ON ALLUVIAL SOIL,
Louisiana Agricultural Experiment Station, Baton Rouge.
R. L. Bengtson, C. E. Carter, H. F. Morris, and J. G. Kowalczuk.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 423-425, March-April, 1983. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Alluvial soils, *Subsurface drainage, Drainage, Soil water, Loam, Soil properties, Erosion, Erosion control, Louisiana, Baton Rouge, Corn, Surface runoff.

A subsurface drainage-runoff-erosion experiment on clay loam soil near Baton Rouge, Louisiana was conducted in 1980 and 1981. The experiment consisted of four plots, of which two were subsurface drained. Corn silage was grown each year. Crop yields from the surface drained plots were 10.30 and 8.36 t/ha, dry matter, for 1980 and 1981, respectively. Yields from the subsurface drained plots were 19.47 and 14.54 t/ha in 1980 and 1981, respectively, which were 89 and 74% more due to subsurface drainage. The water table on the surface drained plots was within 30 cm of the surface for 11.6 days or 11% of the season. The water table on the subsurfaced drained pots was never closer to the surface than 35 cm. Soil loss was 496.8 and 408.5 kg/ha, from surface and subsurface drained plots, respectively, for a 17.8% decrease due to subsurface drainage. (Baker-IVI)
W84-04425

SUBSURFACE DRAINAGE OF AN ALLUVIAL SOIL INCREASED SUGARCANE YIELDS,
Louisiana Agricultural Experiment Station, Baton Rouge.
C. E. Carter, and C. R. Camp.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 426-429, March-April, 1983. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Subsurface drainage, *Crop yield, Drainage, Alluvial soil, Soil properties, Soil types, Sugarcane, Louisiana.

An experiment was conducted on a 10 ha tract of Commerce silt loam in St. James Parish, Louisiana during 1977-1980 to determine the response of sugarcane to subsurface drainage. Subsurface drains 24, 36, and 48 m apart lowered the water table at about the same rate during a 4 year study. Sugarcane yields were increased significantly in 3 of 4 years by subsurface drainage and sugar yields were increased significantly 1 of 4 years. Subsurface drainage for sugarcane is economically feasible, assuming subsurface drain spacing of 48 m and a cost of $1.46/m for installing drains. (Baker-IVI)
W84-04426

REMOTE SENSING OF SOIL MOISTURE WITH MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
T. Schmugge.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 748-753, May-June, 1983. 8 Fig, 2 Tab, 29 Ref.

Descriptors: *Soil water, *Remote sensing, *Microwave radiometers, Satellite technology, Aerial sensing.

Microwave radiometers measure the thermal radiation at wavelengths between 1 mm and about 50 cm that is generated within the soil volume and subsequently emitted through the surface. The fraction of this upwelling radiation incident on the soil surface that is transmitted into the air will be determined by the dielectric properties of a transition layer just below the surface. This fraction can be called the emissivity of the soil and is strongly dependent on the moisture content of the soil in this transition layer. This dependence is due to the large contrast between the dielectric properties of liquid water and those of dry soil. The large dielectric constant of water results from the electric dipole moment of the water molecule. The dielectric constant of water at the lower microwave frequencies is approximately 80 compared with 3 to 5 for dry soils; as a result, the dielectric constant of wet soils can reach values of 20 or more. This produces a range of soil emissivity from about 0.95 for dry soils to 0.6 or less for wet soils. Theoretical studies have indicated that this transition layer is on the order of a few tenths of wavelength thick, i.e., 2 to 5 cm for a 21 cm wavelength. This layer determines the primary soil moisture sampling depth, and its approximate thickness has been confirmed by observations. Results from truck, aircraft, and spacecraft platforms are presented which demonstrate the sensitivity of microwave radiometers to soil moisture variations for a wide range of conditions including light to moderate amounts of vegetative cover. (Author's abstract)
W84-04436

INFILTRATION THROUGH RECONSTRUCTED SURFACE MINED SPOILS AND SOILS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W84-04445

SIMULATING THE HYDRAULIC BEHAVIOR OF A SEWAGE SLUDGE-AMENDED MINE SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. M. Younos, and M. D. Smolen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1397-1400, September-October, 1983. 6 Fig, 1 Tab, 18 Ref, 1 Append.

Descriptors: *Soil amendments, *Sludge disposal, *Land reclamation, *Mine wastes, *Infiltration, Computer models, Simulation, Mine soils, Soil water, Strip mines, Wetting front, Soil hydraulics.

A one-dimensional, Continuous System Modeling Program (CSMP) infiltration model was validated for simulation of infiltration in a mine soil. The validated model was then used to simulate the effect of sewage sludge incorporation on the infiltration and moisture redistribution in a mine soil profile similar to that found at a reclaimed surface mine. Simulation results indicated more rapid advance of the wetting front in sludge amended mine soil as compared with unamended mine soil. The simulation predicted that 1% addition of sludge results in 1.65-fold increase in cumulative infiltration, and 5% addition of sludge results in 2.85-fold increase in cumulative infiltration during a 3 h infiltration period. Further addition of sludge over 5%, however, did not cause any additional increase in infiltration. Use of the CSMP model with measured hydraulic parameters was demonstrated as a tool to evaluate infiltration dynamics and moisture redistribution in sludge-amended mine soil. (Moore-IVI)
W84-04464

NUMERICAL FITTING OF THE GARDNER EQUATION TO HYDRAULIC CONDUCTIVITY AND WATER RETENTION DATA,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
J. R. Hoover, and W. J. Grant.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1401-1408, September-October, 1983. 2 Fig, 4 Tab, 64 Ref, 1 Append.

Descriptors: *Permeability coefficient, *Unsaturated flow, *Soil water, *Water retention, Mathematical equations, Diffusivity, Computer models.

Quantitative application of the theory of unsaturated flow in porous media requires certain parameters of the site to be determined experimentally before it is possible to carry out numerical analysis of water movement in the unsaturated phase for that material. These paramenters include the moisture characteristic function and conductivity function. A procedure for forcing a least squares fit through the first data point of a Gardner-type equations to fit the moisture characteristic and hydraulic conductivity functions was developed. This method provides several measures to determine the goodness of fit. Coefficients for the Gardner equation were determined for many soils data reported in the literature. The method fit the equation to the data well as indicated by the measures of goodness of fit given in the tables. Procedures were developed to convert the length and time units if desired. Coefficients C1 and C2 are unit dependent but C3 is not. The equation for the diffusivity function was derived from the moisture characteristic and conductivity functions. These procedures plus the ease of using the Gardner solution should make it invaluable for use in nu-

merical models instead of using the conventional linear interpolation of tabular data for these functions. (Moore-IVI)
W84-04465

HYDRAULIC GRADIENTS NEAR SUBSURFACE DRAINS AND SOIL EROSION,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
For primary bibliographic entry see Field 8B.
W84-04466

THE PIT BAILING METHOD FOR HYDRAULIC CONDUCTIVITY MEASUREMENT OF ISOTROPIC OR ANISOTROPIC SOIL,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
H. Bouwer, and R. C. Rice.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1435-1439, September-October, 1983. 8 Fig, 2 Tab, 5 Ref.

Descriptors: *Permeability coefficient, *Pit bailing, *Isotropic soils, *Anisotropic soils, Water table, Seepage.

With the pit bailing technique, a hole is dug (normally with a backhoe) to below the groundwater table. After equilibration, the water level in the pit is rapidly (instantaneously) lowered and the subsequent rise of the water level is measured for calculation of the hydraulic conductivity K around the pit. The pit bailing technique was originally developed for septic tank leach field design. However, the method is also useful for in-situ measurement of K for other purposes. This is particularly true for stony soils, where augerhole and other methods are difficult and often fail. Another advantage of the pit method is that the volume of soil on which K is determined is larger than for the augerhole and piezometer methods. The equation originally given for the pit method was based on the Thiem formula, which limited the method to situations where the pit bottom was at or close to the impermeable layer. The geometry of the flow system for the pit method, however, is similar to that for the piezometer method if the water table coincides with the top of the piezometer cavity. Thus, the equation for the piezometer method can also be used for the pit method. This extends the applicability of the pit method to partially penetrating pits in soils that are underlain by either impermeable or very (infinitely) permeable material. Geometry factors for the piezometer method presented by Youngs were extrapolated to the case where the static water table coincides with the top of the cavity. The resulting values then can be used for the pit method. The validity of this approach was demonstrated in a large sand tank where the average K-value yielded by pit-bailing tests on holes of various diameters and depths was 31 m/day as compared to an average value of 37 m/day obtained with one-dimensional and seepage meter methods. In anisotropic soils, K in horizontal and vertical direction can be calculated from the K values obtained from two pits with different geometries. (Author's abstract)
W84-04470

INFILTRATION PARAMETERS FROM FURROW IRRIGATION ADVANCE DATA,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
R. L. Elliott, W. R. Walker, and G. V. Skogerboe.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1726-1731, November-December, 1983. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Infiltration, *Furrow irrigation, Irrigation, Soil water, Model studies, Kostiakov parameters, Soil compaction.

A method is presented for using dimensionless advance curves and furrow irrigation field data to derive the values of the modified Kostiakov infiltration parameters. The model incorporated zero-inertia theory, meaning that the acceleration terms in the equation of motion are neglected. By scaling the variables of the problem, the zero-inertia equations were nondimensionalized, and a set of five dimensionless parameters was derived. Two of the parameters characterize channel geometry and three parameters are functions of the constants of the modified Kostiakov infiltration equation. For a given set of values of these parameters, there is a unique curve relating dimensionless advance times and distances. Dimensionless advance was quite insensitive to the two dimensionless channel geometry parameters. Therefore these advance relationships could be presented graphically as a function of only the three dimensionless infiltration parameters. For discrete values of the infiltration exponent, families of dimensionless advance curves were generated. These curves may be used as an aid in surface irrigation design, or as a means of determining infiltration characteristics. (Baker-IVI)
W84-04481

AGRICULTURAL MANAGEMENT EFFECTS ON SOIL WATER PROCESSES; PART I: SOIL WATER RETENTION AND GREEN AND AMPT INFILTRATION PARAMETERS,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
W. J. Rawls, D. L. Brakensiek, and B. Soni.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1747-1752, November-December, 1983. 10 Fig, 2 Tab, 34 Ref.

Descriptors: *Soil water, *Infiltration, *Tillage, Soil porosity, Soil properties, Organic matter, Water retention.

Tillage significantly alters the surface roughness and total porosity of the disturbed soil layers. A method for predicting changes in soil porosity caused by different types of tillage is developed. The base soil water retention and infiltration equation parameters can be predicted from available or estimated soil properties of percent sand and clay, and percent organic matter. The procedure as presented estimates the effects of tillage on soil porosity. The soil water retention and infiltration parameters can be modified according to the estimated porosity changes. Soil water retention values and infiltration rates and amounts can be predicted by the procedures reported. (Baker-IVI)
W84-04483

INFILTRATION AND SUBSEQUENT EVAPORATION FROM SURFACE-AGGREGATED LAYERED SOIL PROFILES UNDER SIMULATED LABORATORY CONDITIONS,
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
R. Hartmann, and M. De Boodt.
Soil Science, Vol. 137, No. 3, p 135-140, March, 1984. 3 Fig, 4 Tab, 23 Ref.

Descriptors: *Infiltration, *Evaporation, *Soil profiles, *Soil surfaces, *Simulation, Simulation analysis, Soil moisture retention, Polyurea, Soil water, Soil aggregates, Soil sealants, Water conservation, Soil conditioners.

Because limited and erratic precipitation often results in low crop yields, conservation of soil water is one of the major goals for improved crop production. The soil surface condition, due to its intrinsic properties and state of tilth, can profoundly affect such basic processes as infiltration, surface runoff, evaporation, and water distribution within the profile. Improving the aggregate stability of a 2-cm deep surface layer, effected by treatment with a polyurea soil conditioner, significantly increased the water infiltration during simulated rainfall and substantially reduced the evaporation. For the same potential evaporation rate of 5 mm/day, differences in total mean water loss occurred due to different climatic conditions. For a wind speed of 5 km/h and relative humidity of 40%, water losses under untreated and treated surfaces were 50 and 38%, respectively, of the total amount of infiltrated water. With a wind speed of 15 km/h and relative humidity of 80%, water losses were 30 and 11%, respectively. (Murphy-IVI)
W84-04514

ERROR ANALYSIS IN ESTIMATING SOIL WATER CONTENT FROM NEUTRON PROBE MEASUREMENTS: 2. SPATIAL STANDPOINT,
Grenoble-1 Univ. (France).
M. Vauclin, R. Haverkamp, and G. Vachaud.
Soil Science, Vol. 137, No. 3, p 141-148, March, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Error analysis, *Soil water, *Neutron probes, Mathematical studies, Statistical analysis, Analysis of Variance, Sensors.

An analysis of variance has shown that three components are involved in estimating mean water content at a specified depth when a neutron probe is used (instrument, calibration, and location). The soil moisture was measured by two neutron probes at 17 locations regularly spaced on the field. For each probe a unique calibration curve was used for the whole field with both biased and unbiased treatments of the linear correlations. All the measurements at a specified depth were normally distributed regardless of their location, and no spatial structure has been shown for the sampling scheme. In situations of site homogeneity or a large number of sampling points, the calibration component is the greatest contribution to the total variance. It is reduced by considering the unbiased statistical treatment of the neutron probe calibration curve. For higher levels of field heterogeneity, the location component becomes the major contribution to the variance of mean values. It can be decreased by increasing the number of sampling points. Finally, the suitable number of sampling points necessary to provide mean water content values with a prescribed precision is given for the experimental site by applying the central limit theorem. (Murphy-IVI)
W84-04515

AIR AND WATER FLOW IN A SEALED, PONDED VERTICAL SOIL COLUMN: EXPERIMENT AND MODEL,
Grenoble-1 Univ. (France).
J. Touma, G. Vachaud, and J. Y. Parlange.
Soil Science, Vol. 137, No. 3, p 181-187, March, 1984. 5 Fig, 18 Ref.

Descriptors: *Air circulation, *Water flow, *Flow discharge, Vertical soil columns, *Model studies, Infiltration, Soil profiles, Soil water potential, Soil water, Soil-air-water properties, Soil permeabilities.

When considering water movement in a soil, it is generally assumed that the air present in the soil is free to escape and, therefore, has no influence on the infiltration rate. If the air is not free to escape, however, due to the presence of a shallow water table, an impermeable layer, or a lateral obstruction, a significant reduction in infiltration rates occurs. Experimental results dealing with air effects on infiltration and a model that predicts the cumulative infiltration as a function of time is presented. Air pressure reaches a constant value, independent of depth and time. The primary effect of this air pressure is to decrease the water potential at the surface and thus to reduce the infiltration rate to about one-third of its value when air is free to escape. The confined air pressure value can be predicted if permeabilities of soil to air and water are known with precision near saturation. A simple analytical model is presented, which predicts the cumulative infiltation with a good precision, if air pressure or water content at the soil surface is predicted or in practice measured directly. (Murphy-IVI)
W84-04516

CORRELATION BETWEEN THE SOIL MOISTURE REGIME AND THE CLIMATE OF THE AIR LAYER NEAR THE GROUND,
V. P. Volobuyev.
Soviet Soil Science, Vol. 15, No. 2, p 88-98, 1983. 7 Fig, 1 Tab, 11 Ref. Translated from Pochvovedeniye, No. 3, p 51-62, 1983.

Descriptors: *Soil water, *Climates, Seasonal variation, Humidity, Wetting, Soil properties, Physical properties.

Direct observational data on the water regime of oil are limited. An approach is described to deter-nining the probable soil moisture regime from limatic data. The relationship of the soil moisture ontent to the relative humidity of the ground air nd the wetting coefficient K were studied. The nvestigation was based on the data from 25 mete-orological stations and data on the dynamics of soil noisture in regions of these stations. Average early soil moisture contents and the wetting coef-icients K were compared and a correlation was ound. This correlation was then tested against elative air humidity. Given meteorological data n relative air humidity and wetting coefficients or the whole year, the annual soil moisture dy-namics can be confidently calculated. (Baker-IVI)
W84-04523

EFFECT OF PRIMARY CULTIVATION ON THE PERMEABILITY OF FROZEN SOILS,
V. P. Gor'kov.
Soviet Soil Science, Vol. 15, No. 2, p 99-103, 1983. Fig, 4 Tab, 6 Ref. Translated from Pochvove-leniye, No. 3, p 123-127, 1983.

Descriptors: *Frozen ground, *Permeability, *Cul-ivation, Infiltration, Soil properties, Chernozem, Loam, Clay, Snowmelt, Runoff, Thaw, Plowing.

One of the major tasks of modern soil conservation n agriculture is to increase soil permeability during snowmelt in spring. The permeability of frozen soil is much lower than that of thawed soil. Observations made in 1977-81 of the state of the oil during snowmelt in the spring, showed that the oil thaws both from the surface and from the bottom. The state of the soil thawed from the bottom in the absence of freezing or with slight freezing from the surface differs significantly from hat of the soil thawed from the surface. Obviously he greater the number of permeable patches in a ield, the greater its infiltration capacity. Consider-ng that the permeability of frozen soil depends mainly on the state of the plowed layer, one can create conditions for increasing it as early as in autumn. Permeability of the soil during snowmelt n the spring was determined largely by the flatness of the surface of a field. The less level the surface, he greater the number of permeable soil patches, and consequently, the less water will flow downs-ope in the form of surface runoff. This explains the differences in the magnitude of runoff from ridged and level autumn-plowed fields. The most substan-ial increase in the permeability of frozen soils can be achieved by artificially creating at their surface microelevations 15 to 20 cm high. These provide all the prerequisites for the formation of permeable channels in the soil without forming closed depres-sions. (Baker-IVI)
W84-04524

EFFECT OF IRRIGATION ON THE PHYSICAL PROPERTIES OF DARK CHESTNUT SOLON-ETZIC SOILS, NORTHERN CRIMEA,
For primary bibliographic entry see Field 3F.
W84-04525

EVALUATION OF SLUG TESTS IN WELLS CONTAINING A FINITE-THICKNESS SKIN,
GeoTrans, Inc., Reston, VA.
C. R. Faust, and J. W. Mercer.
Water Resources Research, Vol. 20, No. 4, p 504-506, April, 1984. 2 Fig, 2 Tab, 7 Ref. NRC contract NRC-02-81-026.

Descriptors: *Slug test, *Finite-thickness skin, *Performance evaluation, *Well hydraulics, Hydraulic conductivity, Permeability, Mathematical models.

The effects of a finite-thickness skin (low-permeability zone surrounding the well bore face) on the response of slug tests is investigated by using a numerical model and a simple analytical solution. If the possibility of well damage exists, type curves should be used with caution when analyzing slug test data. This is especially true because formation damage cannot be readily discerned from the shape of the response curves alone. If the skin has a finite thickness, type curve matches will provide estimates that may be more representative of skin hydraulic properties than the formation hydraulic properties, that is, the test is only 'seeing' the skin. Such a result could have important consequences in waste disposal applications, where an underestimate of the formation hydraulic conductivity could lead to unrealistic and optimistic travel-time calculations. Because the standard analysis of slug test data may be misleading under certain formation conditions, the development of practical curve-matching techniques for finite-thickness skins would be useful. This result is different from that obtained by using an analytical solution for a skin of infinitesimal thickness. (Murphy-IVI)
W84-04575

2H. Lakes

RELATIONSHIPS AMONG CATCHES, FISHING EFFORT AND RIVER MORPHOLOGY FOR EIGHT RIVERS IN AMAZONAS STATE (BRAZIL), DURING 1976-1978,
Universidade Federal do Maranhao, Sao Luis (Brazil).
M. Petrere, Jr.
Amazoniana, Vol. 8, No. 2, p 281-296, December, 1983. 7 Fig, 3 Tab, 20 Ref.

Descriptors: *Fisheries, *Rivers, *Morphology, *Amazonas State, *Brazil, Floodplains, Multiple regression analysis, Mathematical equations, Commercial fishing.

An equation was sought which was to be used to predict the commercial landings in Manaus (Brazil) and examine the correlations between four variables believed to determine the catches. The commercial fishery in the Amazonas State is multigear and multispecific. The rivers Negro, Branco, Purus, Jurua, Jutai, Madeira, Solimoes (+Japura) and Amazonas were selected and a multiple regression analysis undertaken to explain the annual catches landed by the fishing fleet which operates from Manaus in terms of the annual number of trips per river, the annual number of fishermen, the maximum length of the river channel, and its associated floodplain. For the eight rivers, the annual number of fishermen and dummy variables, which identify the rivers, explain 98.8% of the landings at Manaus market. Partial correlation analysis suggests that only the most productive floodplains are actively sought by professional fishermen. Any empirical model intended to predict the commercial catches in Amazonas State must take the fishing effort into consideration. (Baker-IVI)
W84-04272

SPATIAL HETEROGENEITY OF PHYTOPLANKTON IN THE LOKKA RESERVOIR, FINNISH LAPLAND,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
R. I. Jones, and V. Ilmavirta.
Annales Botanici Fennici, Vol. 20, No. 4, p 391-397, 1983. 8 Fig, 1 Tab, 28 Ref.

Descriptors: *Lokka reservoir, *Phytoplankton, *Spatial distribution, Distribution, Flagellates, Diatoms, Primary production, Chemical properties, Finnland.

Phytoplankton primary production, cell volume and species composition were studied together with some chemical parameters along two transects in Lokka reservoir during the period 16-17 July 1976. The brown water color caused rapid changes in water. Diatoms predominated in the phytoplankton in the deepest layers at the Lokka dam, but flagellates, mainly cryptophytes, were dominant at the surface. Over 50% of the total cell volume was composed of flagellates. The primary production showed a steep vertical gradient but the horizontal variation was small. (Author's abstract)
W84-04273

VERTICAL DISTRIBUTION OF BIOMASS AND SPECIES COMPOSITION OF A PERIPHYTIC COMMUNITY ON AN ARTIFICIAL SUBSTRATE IN AN OLIGOTROPHIC WATER-SUPPLY LAKE,
Lester B. Pearson Coll. of the Pacific, Victoria (British Columbia).
S. Lang, and A. Austin.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 269-286, February, 1984. 5 Fig, 1 Tab, 54 Ref.

Descriptors: *Oligotrophic lakes, *Biomass, *Periphyton, *Vertical distribution, *Species composition, Oligotrophic lakes, Distribution, Water depth.

Periphyton communities accumulating over 373 and 408 days respectively on nylon braided lines anchored vertically throughout the entire 52 m depth of an oligotrophic water supply lake showed significant biomass at considerable depth. The standing crop or biomass accumulated was assessed by three methods - air dry weight, chlorophyll-a adjusted for phaeophytin, and by species numbers and individual counts. All three methods gave values for maximum biomass between depths of 4 and 6 m with much lower values towards the surface but with appreciable growth occurring down to 10-11 m. Examination of a truncated data matrix which contained 85% of the information appeared to exhibit a pattern of distribution of species with depth revealing what could be described as four depth zones. The depth distribution of 19 species were plotted against depth to illustrate their position within the apparent depth zones observed. The data indicate, at least for clear oligotrohpic lakes, that care should be taken in selecting a depth, or depths, at which periphyton is collected or sampled using artificial surfaces, if obtaining data representative of species accumulating to maximum biomass is important. (Baker-IVI)
W84-04276

THE EFFECT OF ARTIFICIAL INFLOW ON THE 12C PRIMARY PRODUCTIVITY OF PHYTOPLANKTON IN LAKE BLED,
Ljubljana Univ. (Yugoslavia).
D. Vrhovsek, P. Stegnar, and I. Kavcic.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 287-295, February, 1984. 8 Fig, 16 Ref.

Descriptors: *Primary productivity, *Phytoplankton, *Lake Bled, *Yugoslavia, Radovna River, Alpine regions, Eutrophic lakes, Alpine lakes, Light, Water temperature.

C-12 primary productivity of phytoplankton was measured in the eutrophic alpine Lake Bled from June to November 1978. Temperature, dissolved oxygen, photosynthetically active light and the quantitative evaluation of phytoplankton were measured through the vertical profile. A summer temperature stratification was present until November when homothermia appeared. Light did not present a limiting factor for primary productivity, except during June. The highest primary productivity was in October; the lowest in July. Inflow of the Radovna considerably influenced the primary productivity mainly because of low temperatures and upwelling of bottom layers. The effect was more pronounced when differences in temperatures through the vertical profile were small. In the layers above the metalimnion primary productivity was stimulated and depressed below. Primary productivity in Lake Bled was to a greater extent influenced by inflow from the Radova, species composition, temperature and underwater light than by the amount of phytoplankton present. (Baker-IVI)
W84-04277

OPTICAL PROPERTIES OF NEW ZEALAND LAKES; I. ATTENUATION, SCATTERING, AND A COMPARISON BETWEEN DOWNWELLING AND SCALAR IRRADIANCES,
Department of Scientific and Industrial Research, Taupo (New Zealand). Div. of Marine and Freshwater Sciences.
C. Howard-Williams, and W. F. Vincent.
Archiv fur Hydrobiologie, Vol. 99, No. 3, p 318-330, February, 1984. 4 Fig, 2 Tab, 16 Ref.

Descriptors: *Lakes, *Optical properties, *New Zealand, Downwelling, Scalar irradiances, Chlorophyll, Radiation, Light, Suspended solids, Color, Turbidity.

Measurements of downward and upward photosynthetically active radiation (PAR) with a cosine-corrected quantum sensor, and scalar irradiance with a spherical quantum sensor were made on 34 optically different New Zealand lakes. From these data the extinction coefficients, the coefficient of backscattering, reflectance, and the ratio of scalar to downward irradiance were calculated. These measures were related to chlorophyll-a, total suspended solids and the amount of dissolved color in the lake water. Upwelling irradiance was high in turbid lakes and low in humic lakes. The data showed that in turbid lakes the measurements of downward irradiance can underestimate the number of quanta available to algal cells by as much as 60%. (Baker-IVI)
W84-04278

ECOLOGY OF AEROBIC HYDROGEN-OXIDIZING BACTERIA IN TWO FRESHWATER LAKE ECOSYSTEM,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
B. Schink, and J. G. Zeikus.
Canadian Journal of Microbiology, Vol. 30, No. 2, p 260-265, February, 1984. 4 Fig, 26 Ref. Department of Energy grant 80EV02162.

Descriptors: *Bacteria, *Ecology, *Aerobic bacteria, *Hydrogen oxidation, *Hydrogen, *Lakes, Knallgas Bacteria, Microbial decomposition, Meromictic lakes, Holomictic lakes, Hydrogen cycling, Knaack Lake, Lake Mendota, Wisconsin.

Molecular hydrogen is produced by anaerobic microbial decomposition, photosynthetic activities or as a byproduct of biological nitrogen fixation. However, hydrogen evolution into the atmosphere and hydrogen concentrations in aquatic ecosystems are limited because of concomitant hydrogen consumption by microorganisms. Hydrogen concentration, hydrogenase activity, and numbers of aerobic hydrogen-oxidizing bacteria were measured in the water column and sediment surface of a meromictic and a holomictic lake (Lake Mendota, Knaack Lake, Wisconsin). Low but detectable concentrations of hydrogen (0-4 microL/mL) and numbers of aerobic hydrogen-oxidizing bacteria (0-50 cells/mL) were present in the upper photic zones in both lakes. Hydrogen concentrations, numbers of aerobic hydrogen-oxidizing bacteria, and hydrogenase activity were not significant in the anoxic water column or at the chemocline. Highest levels of oxygen-dependent hydrogenase activity and of aerobic hydrogen-oxidizing bacteria occurred in the hydrogen-depleted surface sediments. The prevalent strains in both lakes were characterized and assigned as species of Pseudomonas or Aquaspirillum. The data suggest that oxygen-dependent hydrogen oxidation by aerobic chemotrophs is of minor significance to hydrogen cycling in these lake ecosystems. (Murphy-IVI)
W84-04288

THE ECOLOGY OF EPIPELIC ALGAE OF FIVE WELSH LAKES, WITH SPECIAL REFERENCE TO VOLVOCALEAN GREEN FLAGELLATES (CHLOROPHYCEAE),
University Coll. of North Wales, Bangor. School of Plant Biology.
C. M. Happey-Wood, and J. Priddle.
Journal of Phycology, Vol. 20, No. 1, p 109-124, March, 1984. 11 Fig, 4 Tab, 63 Ref. Environment Research Council grant GR3-3659.

Descriptors: *Epipelic algae, *Mountain lakes, *Volvocalean, Diatoms, Blue-green algae, Population dynamics, Population density, Biological properties, Lake Llydaw, Lake Cwellyn, Lake Padarn, Lake Maelog, Lake Coron, North Wales.

The ecology of epipelic algae on the marginal sediments of five Welsh lakes was studied over an annual cycle. The lakes, Llydaw, Cwellyn, Padarn, Maelog and Coron ranged from very oligotrophic to nutrient-rich. Attention was focused on chlamydomonad flagellates, diatoms, blue-green algae and euglenoids and the different proportions of these in algae in the epipelon of lakes of contrasting water quality. A total of 75 algal taxa was found in the five lakes, 25 were species of volvocalean flagellates. Mean annual population density of these flagellates differed by an order of magnitude between the lakes. The greatest population density was recorded for Chlamydomonas anticontata Schiller in nutrient-rich Llyn Maelog. Twenty species of pennate diatoms were recorded frequently in the epipelon. In the nutrient-rich lakes, Maelog and Coron, pennate diatoms were dominant on the sediments, where they exhibited population maxima in spring and autumn. Increase in numbers of epipelic diatoms was recorded when silica concentrations were minimum in the overlying lake waters. Navicula hungarica Grun. achieved the maximum population density, 260,000 cells/sq cm. Euglenoids formed large epipelic populations during late-summer and autumn in these nutrient-rich lakes. Blue-green algae were more important, proportionally, in the nutrient-poor mountain lakes, which had sediments of higher organic content. Chlamydomonads were the major algal component of the epipelon in the mountain lakes, Llydaw and Cwellyn, where the sediments were characterized by larger particle size, and higher organic content. In the nutrient-rich lakes, where the sediments had higher calcium content, chlamydomonads formed significant populations only during spring and summer, when nutrient levels were minimal in the overlying lakewaters. (Murphy-IVI)
W84-04322

AMIDOHYDROLASE ACTIVITY IN NATURAL WATERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. T. Frankenberger, Jr., and J. B. Johanson.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 319-329, 1983. 6 Fig, 3 Tab, 25 Ref.

Descriptors: *Amidohydrolase activity, *Natural waters, Aquatic enzymes, Urease, Amidase, L-Asparaginase, L-Glutaminase, Hydrogen ion concentration, Chemical properties, Assay, Kinetics, Enthalpy, Cycling nutrients.

Urease, amidase, L-asparaginase, and L-glutaminase were assayed in three freshwater lakes and an oceanic water sample by utilizing urea, formamide, L-asparaginase, and L-glutamine as substrates, respectively. The activity of L-glutaminase as a function of pH increased from 6.0 to 7.0 and thereafter declined with decreasing H(+) ion concentration. Each substance exhibited similar pH dependencies (optimal pH 7-8) when measured between 6.0 and 11.0. By using the Lineweaver-Burk plot, the Km values averaged 1.1 mM for urease, 5.1 mM for amidase, 3.0 mM for L-asparaginase, and 5.9 mM for L-glutaminase. The linear relationship when 2 or less cu cm of water was used indicated that neither the substrate concentration nor the products formed influenced the reaction rates of amidohydrolases sample. However, deviations from linearity were observed when greater than 2 cu cm of water were used in the assays. This relationship was particularly evident with the higher activties of amidohydrolases as in the case of L-glutaminase and amidase. A substrate concentration of 0.1 M was satisfactory for the assay of amidohydrolase activity in surface waters by essentially following zero-order kinetics. The reaction velocity of urease, amidase, L-asparaginase, and L-glutaminase increased with increasing temperatures up to 50, 50, 60, and 60 degrees C, respectively, while further increases in temperature decreased the reaction rates. The enthalpies of activation of urease, amidase, L-asparaginase, and L-glutaminase in three freshwater lakes and an oceanic water sample averaged 40.3, 32.0 32.6, and 19.5 kJ/mole, respectively. (Murphy-IVI)
W84-04340

THE EFFECT OF PHOSPHATE ON BACTERIAL BIOMASS PRODUCTION IN WATERS OF LAKES OF THE JORKA RIVER DRAINAGE BASIN,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 5C.
W84-04341

BIOLOGY OF DREISSENA POLYMORPHA (PALL.) SETTLING ON STYLON NETS AND THE ROLE OF THIS MOLLUSC IN ELIMINATING THE SESTON AND THE NUTRIENTS FROM THE WATER-COURSE,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrozoology.
Z. Piesik.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 353-361, 1983. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Dreissena, *Cycling nutrients, *Seston, Self-purification, Nutrient removal, Biofiltration, Biofilters, Oder River.

Dreissena polymorpha is the most common mollusk in our waters. It leads a settled mode of life and participates in processes of biofiltration, biosedimentation of the seston and accumulation of various mineral compounds thereby affecting conditions of the water environment. Biology of a 1-year-old population of Dreissena polymorpha settled on a stylon net barrier set in one of the downstream River Oder channels was studied. A mass settling of larval Dreissena was found to occur on the barriers from May through October. A mean density of Dreissena on the nets studied ranged from 1 530 to 448 970 indiv./sq m of net area. Only 0.3% of the bivalve survived the winter. The Dreissena settled on the nets fell prey to various predators, mainly Orconnectes limosus and Fulica atra. The bivalve living on the barriers eliminated dissolved nutrients, CaCO3, and other mineral salts from the water. (Murphy-IVI)
W84-04342

EUTROPHICATION IN PEEL INLET - III A MODEL FOR THE NITROGEN SCENARIO AND A RETROSPECTIVE LOOK AT THE PRELIMINARY ANALYSIS,
Australian National Univ., Canberra. Centre for Resource and Environmental Studies.
R. B. Humphries, G. M. Hornberger, R. C. Spear, and A. J. McComb.
Water Research, Vol. 18, No. 4, p 389-395, 1984. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Eutrophication, *Peel Inlet, Nitrogen cycle, Simulation analysis, Mathematical model, Performance evaluation, Nitrogen fixation.

The first two papers in this series described a speculative mathematical model for phosphorus dynamics in Peel Inlet, Western Australia. In this third paper of the series, the structure of and results from an a priori speculative simulation model of the nitrogen dynamics of eutrophic Peel Inlet are described. This simulation exercise indicated that nitrogen limitation of Cladophora growth rarely occurred. The results of this simulation exercise, and those of the earlier study of the phosphorus scenario, are then compared with field and laboratory data collected subsequently. This comparison indicates that the preliminary speculative simulation technique is a powerful method for the definition of the critical uncertainties in the knowledge of an environmental system, and therefore for the direction and planning of future research. Furthermore, the simulations correctly identified phosphorus, rather than nitrogen, as the major limiting nutrient for macroalgal growth in Peel Inlet. (Murphy-IVI)
W84-04348

TIME-VARIANT DIFFERENCES IN CHEMISTRY AMONG FOUR SMALL STREAMS,
P. Teti.
Water Resources Research, Vol. 20, No. 3, p 347-359, March, 1984. 1 Fig, 6 Tab, 58 Ref. National Research Council of Canada grant NRC 67-7073.

Descriptors: *Stream water, *Water chemistry, *British Columbia, Silica, Calcium, Potassium, Sodium, Magnesium, Snowmelt, Groundwater, Runoff, Lithology, Time-variance, Mountain streams.

Concentrations of the major cations and silica were monitored in four small British Columbia Coast Mountain streams during the 1976 snowmelt season. The fours streams could be grouped into three unique classes using logarithmically transformed calcium and potassium concentrations. The two most similar basins fed streams that were chemically indistinguishable. The next most similar basin yielded runoff that was chemically similar to the other two except for unusually low K(+) concentration, possibly due to a shortage of biotite in the bedrock. The fourth stream had unusually high Ca(++), Mg(++), Na(+), and silica concentrations due to the long residence time of groundwater from metamorphic rocks in its basin. Another different feature of that basin was the earlier depletion of its spring snowpack due to its south aspect. Time-variant differences in chemistry among streams were measured as changing ratios of solute concentrations over time. Differences among streams were time-variant due to time variance of interbasin runoff components. The relative contribution of groundwater increased in the basin with the metamorphic rocks and decreased in the other three basins over the summer. The chemical differences among streams were reflected in solute loads as well as solute concentrations. Therefore the major components of variable runoff and solute sources in the study area was high runoff and low solute yield from three basins on granite and low runoff but high solute yield from a basin on metamorphic rocks. (Author's abstract)
W84-04359

THE EFFECT OF TEMPERATURE ON PHOTOSYNTHETIC AND RESPIRATORY ELECTRON TRANSPORT SYSTEM ACTIVITY IN THE SHALLOW AND DEEP-LIVING PHYTOPLANKTON OF A SUBALPINE LAKE,
California Univ., Davis. Div. of Environmental Studies.
J. C. Priscu, and C. R. Goldman.
Freshwater Biology, Vol. 14, No. 2, p 143-155, April, 1984. 2 Fig, 2 Tab, 57 Ref.

Descriptors: *Lakes, *Phytoplankton, *Temperature effects, Subalpine regions, Photosynthesis, Respiration, Castle Lake, Seasonal variation.

The influence of temperature on in vivo photosynthetic and in vitro respiratory electron transport system activity was determined over the season for the 3 m and a 20 m phytoplankton community in Castle Lake. The optimum temperature of photosynthesis was significantly higher at 3 than at 20 m. Seasonally, the photosynthetic temperature optimum increased when the blue-green alga Chroococcus limneticus Lemm. was present. Temperature optima were not significantly different in experiments conducted under limiting or saturating photosynthetic photon flux densities. Respiratory electron transport system activity usually began to inactivate between 19 and 20 degrees C. These findings demonstrate that the epilimnetic and hypolimnetic phytoplankton communities in Castle Lake are physiologically distinct with regard to their temperature characteristics. (Baker-IVI)
W84-04370

CHANGES IN SEDIMENT NUTRIENT CONTENT IN A SUBARCTIC LAKE SUBJECTED TO LAKE FERTILIZATION,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. Bjork-Ramberg.
Freshwater Biology, Vol. 14, No. 2, p 156-163, April, 1984. 8 Tab, 15 Ref.

Descriptors: *Lakes, *Nutrients, *Lake sediments, Sedimentation, Phosphorus, Nitrogen, Denitrification, Fertilization, Lake Gunillajaure, Sweden, Stratification.

Phosphorus and nitrogen concentration in the surface sediment was analyzed before, during and after fertilization of a small, stratified, subarctic lake. During stratification 70% of the added nutrients were deposited in the epilimnion sediment. After 2 years of fertilization, there was a significant increase of both nutrients at all water depths, although values were 30-50% higher per square meter in the shallow areas. Nutrient budget calculations based on the sediment analyses showed that 75% of the added phosphorus and 45% of the nitrogen were accumulated in the sediment after fertilization. The sediment velocity in Lake Gunillajaure was found to be very low. This, in conjunction with sediment nutrient uptake experiments, indicates that the most important pathway of nutrients to the sediments is a direct uptake by the epipelic algae as the phosphate uptake capacity by the algae on the sediment is very high. Much of the phosphorus that is taken up the epipelic algae must have been excreted or released on death but still retained in the sediment. Denitrification from the sediment in Lake Gunillajaure seems to be insignificant as the sediment analyses and the mass balance calculations show such good agreement. (Baker-IVI)
W84-04371

USE OF ATP AND CARBON:NITROGEN RATIO AS INDICATORS OF FOOD QUALITY OF STREAM DETRITUS,
Guelph Univ. (Ontario). Dept. of Zoology.
B. R. Taylor, and J. C. Roff.
Freshwater Biology, Vol. 14, No. 2, p 195-201, April, 1984. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Detritus, *Streams, *Nutrients, Adenosine triphosphate, Carbon, Nitrogen, Phosphates, Decomposing organic matter, Organic matter, Temperature effects, Seasonal variation, Sediments, Stream flow.

As part of a larger study of gradients in lotic ecosystems, the biocarbon to particulate organic matter ratio (BIOC/POM) and C/N ratios of suspended and benthic stream detritus were assessed along three physically different streams in order to ascertain how these parameters changed with downstream distance, and which physical features were associated with these changes. Large differences in sediment adenosine triphosphate (ATP) fractions between upstream and downstream Hanlon Creek reflect the upstream allochthonous inputs of woody material, while the downstream reaches receive conditioned material. Sediment ATP fractions in Blue Springs Creek were comparable to upstream Hanlon Creek which has similar organic inputs. The high water temperatures in the Speed River probably account for the high ATP levels of sediments found there. Sediment ATP appears to be a valuable and sensitive indicator of changes in detritus food quality between reaches or through time in these headwater streams. C/N ratios of sediments showed much the same pattern of differences as ATP but were less variable. By contrast, the ATP content and C/N ratios of suspended organic matter showed no systematic variation between upstream and downstream or between warmer open and cooler shaded areas, probably due to the very short residence time of suspended particles. (Baker-IVI)
W84-04374

ORGANIC GEOCHEMISTRY OF SUSPENDED AND SETTLING PARTICULATE MATTER IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
P.A. Meyers, M. J. Leehneer, B. J. Eadie, and S. J. Maule.
Geochimica et Cosmochimica Acta, Vol. 48, No. 3, p 443-452, March, 1984. 4 Fig, 4 Tab, 46 Ref.

Descriptors: *Lakes, *Particulate matter, Geochemistry, Suspended solids, Sediments, Lake sediments, Carbon, Nitrogen, Fatty acids, Alkanols, Sterols, Aliphatic hydrocarbons, Sediment-water interfaces, Lake Michigan.

Organic matter contained in particulate matter in Lake Michigan waters and sediments has been characterized by C/N ratios and by distributions of biomarker fatty acids, alkanols, sterols, and aliphatic hydrocarbons. Differences in the amount and types of geolipids present in particulate matter found at different depths in Lake Michigan suggest a complex interplay of organic matter production alteration, and destruction which accompanies the settling of sediment particles through the water. Suspended particulates in the top meter of the open lake waters contain a major component of terrigenous lipid matter brought to these locations by eolian transport. Settling particles in the metalimnion contain predominantly aquatic lipid matter. Organic matter associated with sinking particles undergoes substantial degradation during sedimentation in Lake Michigan. Aquatic lipid components are selectively destroyed relative to the terrigenous components of this oganic material. Petroleum hydrocarbons are associated with particles collected in sediment traps in the metalimnion but not with shallower or deeper particles, evidently as a result of density segregation of settling particles. Resuspension of surficial sediments causes selective removal of finer fractions from the lake bottom and corresponding enrichment of bottom nepheloid layers with these sediment size classes. Because aquatic lipid matter is preferentially associated with the fine fractions, nepheloid particulate matter has an aquatic biomarker character, whereas bottom sediments have a terrigenous character. (Baker-IVI)
W84-04379

RELATIONSHIPS BETWEEN ZOOPLANKTON ABUNDANCE AND CHLOROPHYLL A CONCENTRATIONS IN FLORIDA LAKES,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
D. E. Canfield, Jr., and C. E. Watkins.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 335-344, April, 1984. 1 Fig, 3 Tab, 20 Ref.

Descriptors: *Zooplankton, *Lakes, Florida, Chlorophyll, Limnology, Cladocerans, Copepods, Crustaceans, Rotifers, Seasonal variation, Eutrophication.

Data collected during a limnological survey of 165 Florida lakes were used to examine statistical relations between chlorophyll a concentrations and the abundance of total zooplankton, cladocerans, copepods, crustaceans, and rotifers. Significant positive correlations were found between chlorophyll a concentrations and total zooplankton abundance for both the spring and summer collection periods as well as for the overall collection period. With the exception of summer caldoceran abundance, there were also positive relationships between chlorophyll concentrations and the abundances of the other groups of zooplankton. Therefore increased chlorophyll concentrations should generally result in increased zooplankton abundance in Florida lakes. (Baker-IVI)
W84-04383

EFFECTS OF MULTIPHASE RESTORATION, PARTICULARLY ALUMINUM SULFATE APPLICATION, ON THE ZOOPLANKTON COMMUNITY OF A EUTROPHIC LAKE IN EASTERN WASHINGTON,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 6G.
W84-04386

THE CHARACTERISTICS OF AMMONIUM AND NITRATE UPTAKE BY PHYTOPLANKTON IN LAKE KINNERET,
Kinneret Limnological Lab., Tiberias (Israel).
T. Berman, B. F. Sherr, E. Sherr, D. Wynne, and J. J. McCarthy.
Limnology and Oceanography, Vol. 29, No. 2, p 287-297, March, 1984. 6 Fig, 4 Tab, 51 Ref.

Descriptors: *Nitrate, *Lakes, *Phytoplankton, Lake Kinneret, Seasonal variation, Diurnal variation, Ammonia, Eutrophication.

Seasonal and diurnal patterns of NH4(+) and NO3(-) uptake were determined for Lake Kinneret phytoplankton. In most cases a higher uptake of NH4(+) and NO3(-) was noted among nanoplankton when compared to plankton. Ammonium was always taken up preferentially and the phytoplankton had lower apparent affinity constants for this ion than for NO3(-). When the ambient levels of NH4(+) were low and those of NO3(-) were high,

as during the annual dinoflagellate bloom of Peridinium in February through May, a considerable portion of the total N flux was derived from NO3(-). Changes in light intensity account to some degree for the observed daily fluctuations of specific uptake rates for both NH4(+) and NO3(-). The findings that NO3(-) was used by the dinoflagellates implied that control of the amounts of this nutrient could be important in limiting eutrophication in Lake Kinneret. (Baker-IVI)
W84-04390

THE RELATIVE IMPORTANCE OF BACTERIOPLANKTON AND PHYTOPLANKTON IN PHOSPHOROUS UPTAKE IN FRESHWATER,
McGill Univ., Montreal (Quebec). Dept. of Biology.
D. J. Currie, and J. Kalff.
Limnology and Oceanography, Vol. 29, No. 2, p 311-321, March, 1984. 3 Fig, 2 Tab, 62 Ref.

Descriptors: *Bacteria, *Phytoplankton, *Phosphorus, Natural waters, Lakes, Nutrients, Limnology, Lake Memphremagog.

The hypothesis that bacteria rather than phytoplankton are responsible for most P uptake in situ was tested in Lake Memphremagog by means of size fractionation of P-32 orthophosphate uptake, C-14 glucose uptake and both C-14 bicarbonate uptake and chlorophyll a. In biweekly samples from May to October, particles smaller than 3.0 micrometers accounted for 72-98% of the uptake of orthophosphate. There was no diel variation in the fraction of uptake by particles smaller than 3.0 micrometers. The bacterial contribution to the total community uptake of orthophosphate was estimated to range between 97 and 100% overall samples collected. However, the phoshorus released was taken up almost entirely by the phytoplankton. The bacterioplankton apparently strongly dominates orthophosphate cycling in situ, while the phytoplankton seems to obtain most of its phosphorus from excreted organic P compounds. It remains to be determined how the algae get their phosphorus, if not from orthophosphate, and where the phosphorus goes after it is absorbed by the bacteria. (Baker-IVI)
W84-04391

THE IMPACT OF UNCERTAINTIES IN HYDROLOGIC MEASUREMENT ON PHOSPHORUS BUDGETS AND EMPIRICAL MODELS FOR TWO COLORADO RESERVOIRS,
Geological Survey, Denver, CO.
J. W. LaBaugh, and T. C. Winter.
Limnology and Oceanography, Vol. 29, No. 2, p 322-339, March, 1984. 8 Fig, 2 Tab, 47 Ref.

Descriptors: *Phosphorus, *Reservoirs, Colorado, Hydrologic budget, Groundwater flow, Watersheds, Chemical analysis, Model studies.

Water budgets and related chemical budgets of aquatic ecosystems commonly are interpreted without reference to uncertainties resulting from errors of measurement. The importance of such uncertainties in the use and interpretation of the phosphorus budgets of two Colorado reservoirs was determined. Water budgets were calculated from data from on-site measurement of precipitation, evaporation, reservoir stage, outflow, and inflow from the major river of each reservoir. Direction of groundwater flow was determined with existing well information and seepage meters. Contributions of ungauged watersheds and groundwater were estimated from the residual of measured water budget terms. The need to measure each component of a water budget with a least error method for the residual of a budget to have any hydrologic meaning was demonstrated. The residual term of the water budget, commonly used to estimate contributions from unmeasured components, could be accounted for almost entirely by measurement error. This can occur even in systems dominated by a hydrologic component that can be measured with minimal error, such as the streamflow measurements reported here. Errors in measurement of loading can be equal to, or exceed, the model error of an empirical model, particularly when the residual term of the water budget accounts for most of the loading. Using most empirical models in attempts to assess or manage the nutrient input of a water body whose loading is attributed mostly to a residual of a budget would result in a large degree of uncertainty. (Baker-IVI)
W84-04392

THE SIGNIFICANCE OF DESMIDS AS INDICATORS OF THE TROPHIC STATUS OF FRESHWATERS,
Amsterdam Univ. (Netherlands). Hugo de Vries Lab.
P. F. M. Coesel.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 388-393, March, 1984. 18 Ref.

Descriptors: *Desmids, *Bioindicators, *Trophic level, Netherlands, Natural waters, Primary productivity, Alkalinity, Chlorophyta.

The presence of the chlorophycean group of the Desmidiaseae is usually supposed to be associated with an oligotrophic environment. In most plankton quotients, including the 'compound index' which is the most popular one, the desmids appear in the denominator of the fraction as being representative of the oligotrophic side of the trophic range. Reports concerning the ecological demands of desmids are compared with results obtained from studies of various habitat types in the Netherlands, to determine the significance and usefulness of desmids as indicators of trophic level. Ecological conditions under which a well-developed desmid flora can be found indicate a low productive environment to be the primary requirement. The low electrolyte content (conductivity <100 micro S/cm) and low alkalinity (HCO3(-) <0.5 meq/l) regularly associated with an oligotrophic habitat do not appear to be essential. The richest desmid assemblies were encountered at sites with moderately high electrolyte contents, especially in situations with some spatial (habitat differentiation) or temporal (niche differentiation) variation. (Baker-IVI)
W84-04398

LIGHT, STRATIFICATION AND ZOOPLANKTON AS CONTROLLING FACTORS FOR THE SPRING DEVELOPMENT OF PHYTOPLANKTON IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 394-404, March, 1984. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Phytoplankton, *Population dynamics, *Lake Constance, *Stratification, *Light, *Zooplankton, Seasonal variation, Eutrophication, Algal growth.

The patterns of phytoplankton growth and decline during the spring bloom and the following clearwater phase in Lake Constance have been studied on the basis of cell counts with short-term sampling intervals. Attempts are made to explain the patterns of increase and decrease of the four dominant algal species Rhodomonas lens, Rhodomonas minuta, Cryptomonas ovata, and Stephanodiscus hantzcchii by the antagonistic influence of a single growth factor (light) and a single loss factor (zooplankton grazing). Rapid algal growth did not start before the lake became stratified at the start of April. A bad weather period at the end of April partially destratified the lake, causing a marked decrease in phytoplankton biomass. At the end of May, heavy zooplankton grazing reduced algal crops to levels similar to those before the spring bloom, leading to the well-known clearwater phase which lasted until late June. The antagonism of only two factors, light and zooplankton pressure, is sufficient to explain phytoplankton dynamics in the spring phase of Lake Constance. Therefore, other environmental factors are of only minor importance. (Baker-IVI)
W84-04399

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 3,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
J. Liden.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 411-429, March, 1984. 10 Fig, 34 Ref.

Descriptors: *Lakes, *Iron, *Ice, Ice cover, Diffusion, Natural waters, Hypolimnion, Transport.

The concentrational control of Fe(2+) has been studied in the anoxic hypolimnion of an ice covered lake with special reference to redox equilibria with the suspended phase. A comparison between the two anoxic hypolimnion formed during summer and winter in Lake Lovosundet shows that although the chemistry in qualitative terms is similar, that is, the release of Fe(2+), Mn(2+), and HCO3(-), the different processes are not quantitatively equal. The vertical distribution of species such as Fe(2+) within the anoxic water column is determined mainly by the hydrodynamical and diffusional processes. No single and truly thermodynamical redox level existed in the anoxic water column. (Baker-IVI)
W84-04400

LIMNOLOGICAL STUDIES ON THE EUTROPHICATION OF LAKE WOLDERWIJD, A SHALLOW HYPERTROPHIC OSCILLATORIA DOMINATED LAKE IN THE NETHERLANDS,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
C. Berger, and A. Bij de Vaate.
Schweizerische Zeitschrift fur Hydrologie, Vol. 45, No. 2, p 458-479, March, 1984. 9 Fig, 7 Tab, 50 Ref.

Descriptors: *Lakes, *Phytoplankton, Lake Wolderwijd, Seasonal variations, Nutrients, Phosphorus, Algae, Limnology, Eutrophication, Netherlands.

Lake Wolderwijd has an area of 2700 ha, mean depth of 1.5 m, residence time of 0.9 year, phosphorus load of 0.5 - 1.5 g/Psq m/yr. Phytoplankton was dominated by the blue-green alga Oscillatoria agardhii Gom. which formed a persistant bloom. Two other blue-green algae species, O. redekei v. Goor and Aphanizomenon flos-aquae (L.) Ralfs, were important in part of the year. Mean light intensity and temperature are main factors governing the competition between the algae species. Phytoplankton biomass reached summer maxima of 30 to 40 mg/l ash free dry weight. Biomass in winter was only 50% lower, on chlorophyll-a basis only 35%. The annual courses of concentration of nutrients, organic substances, part P, part N, part C, chlorophyll-a and ash-free dry weight are given beside the annual averages and correlation factors between the several biomass parameters. The features of the lake form, together with sufficient nutrients, an environment where self-regulation, via biomass, is possible to a high degree. (Baker-IVI)
W84-04401

SIZE-FRACTIONATION OF ALKALINE PHOSPHATASE ACTIVITY IN LAKE WATER BY MEMBRANE FILTRATION,
Oklahoma State Univ., Stillwater. Dept. of Microbiology.
D. A. Francko.
Journal of Freshwater Ecology, Vol. 2, No. 3, p 305-309, December, 1983. 3 Tab, 17 Ref.

Descriptors: *Lakes, *Phosphates, *Membrane filters, Filtration, Oklahoma, Sangre Isle Lake, Algae.

Alkaline phosphatase activity present in the surface waters of five north central Oklahoma lakes was partitioned into four size classes by membrane filtration. The 1.2 micro m membrane filters retained 0-86% of the total APA. Filters of 0.45 micro m size retained only slightly more APA than 1.2 micro m filters and less than 6% of any APA in the lakewater samples was able to pass through a 0.22 micro m filter. Dissolved calf APA was not retained to any appreciable extent by any of the membrane filters used. The algae genera present in

waters from these lakes during the study period were retained by the 1.2 micro m filters, as were visible bacteria in about the 1-2 micro m size class. Great homogeneity was apparent in the sources of APA in lake water. In some lakes, algal APA may predominate while in other systems, bacterial or dissolved APA may comprise the bulk of APA. (Baker-IVI)
W84-04402

REGIONAL APPLICATION OF AN INDEX OF BIOTIC INTEGRITY BASED ON STREAM FISH COMMUNITIES,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
K. D. Fausch, J. R. Karr, and P. R. Yant.
Transactions of the American Fisheries Society, Vol. 113, No. 1, p 39-55, January, 1984. 9 Fig, 3 Tab, 43 Ref. EPA grants R-806391 and CR-810745.

Descriptors: *Index of biotic integrity, *Fish, *Biological communities, *Stream biota, Watersheds, Aquatic habitats, Species composition.

The recently proposed index of biotic integrity (IBI) was evaluated for several watersheds throughout the midwestern United States. Five of the community metrics comprising the IBI depend on the number of fish species present and must be adjusted for changes in expected species richness with stream size or zoogeography. We use basic relationships of fish species richness versus stream size, calculated from historical fish community data for seven watersheds, to define lines of maximum species richness. These lines are used to predict attributes of 'excellent' fish communities, the basis of comparison for assigning scores to 5 of 12 IBI metrics. When zoogeographic and stream-size factors were accounted for in assigning scores, the IBI accurately reflected watershed and stream conditions. As partial tests of the IBI, we found that the index conforms to knowledge of biologists familiar with several watersheds, is independent of stream order in homogeneous watersheds, and is not biased upwards in generally degraded watersheds. Furthermore, analysis of undisturbed fish communities in Illinois and Kentucky support criteria set for percentages of omnivorous individuals and insectivorous cyprinids expected in 'excellent' fish communities. Comparison of maximum species richness lines reveals two groups of similar fish communities, those in woodland streams (Illinois, Michigan, and Kentucky) and those in Great Plains streams (Nebraska, North and South Dakota). We suspect similarities result from ecological factors relating to physical habitat and biotic interactions, rather than from factors such as geologic and climatic history. (Author's abstract)
W84-04414

THE INFLUENCE OF NUTRIENT AVAILABILITY ON THE ECOSYSTEM BEHAVIOUR OF A SALT WATER LAKE,
Waterloopkundig Lab., Delft (Netherlands).
I. de Vries, and M. F. Veul.
Water Science and Technology, Vol. 16, No. 1/2, p 121-130, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Saline water, *Lakes, *Nutrients, Silicon, Nitrogen, Phosphorus, Primary production, Mineralization, Phytoplankton, Detritus, Decomposing organic matter, Denitrification.

The influence of the availability of silicon, nitrogen and phosphorus on the behavior of the ecosystem in the salt Lake Grevelingen is evaluated. Dynamic calculation of detritus formation resulting from mortality of phytoplankton and microphytobenthos was used to quantify nutrient cycling. Mineralization as a function of temperature and substrate concentration was also included in the calculations. During the summer portion of the year silicon and nitrogen are reversibly mixed in bottom detritus. This implies that primary production depends on the balance between accumulation of detritus in the bottom and mineralization. In contrast, the dynamics of phosphorus depend only to a minor extent on primary production and net loading. The net yearly load of nitrogen equals the amount of nitrogen present in the waterphase during the winter time. From a management point of view, stratification inhibits denitrification and should therefore be avoided. (Baker-IVI)
W84-04499

TURBIDITY CURRENTS: MONITORING THEIR OCCURRENCE AND MOVEMENT WITH A THREE-DIMENSIONAL SENSOR NETWORK,
California Univ., Los Angeles. Dept. of Geography.
F. H. Weirich.
Science, Vol. 224, No. 4647, p 384-387, April, 1984. 3 Fig, 6 Ref.

Descriptors: *Turbidity currents, *Three-dimensional sensor, Water currents, Glacial lakes, Optical sensors, Thermal sensors, Sensors, Underflow, Surges, Dynamics, Flow pattern, Erosion, British Columbia.

The general laws describing the movement of turbidity currents have been the subject of considerable study. Yet the collection of field data on such phenomena in differing environments has been limited to measurements over relatively short time spans and at only a few measurement points. Detailed field data on the occurrence, flow pattern, and internal dynamics of both surge and continuous turbidity currents have been obtained with a three-dimensional array of optical and thermal sensors. The array, operated in a glacial lake in southeastern British Columbia, collected detailed information on the character of surge events with velocities reaching 110 centimeters per second and continuous underflows exceeding 90 centimeters per second. The findings (i) indicate that such currents are frequent events, occurring with density differences between the incoming stream water and the lake water as low as 0.19 kilogram per cubic meter of water; (ii) document the differences in the initiation and internal characteristics of the continuous and surge events; and (iii) support the concept of erosion by turbidity currents. (Murphy-IVI)
W84-04535

GEOTHERMAL RESERVOIR SIMULATION USING NONEQUILIBRIUM THERMODYNAMICS,
Princeton Univ., NJ.
For primary bibliographic entry see Field 2A.
W84-04536

MEASUREMENTS OF DIEL RATES OF BACTERIAL SECONDARY PRODUCTION IN AQUATIC ENVIRONMENTS,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
B. Riemann, and M. Sondergaard.
Applied and Environmental Microbiology, Vol. 27, No. 4, p 632-638, April, 1984. 6 Fig, 4 Tab, 26 Ref.

Descriptors: *Measuring instruments, *Bacteria, *Secondary productivity, *Aquatic environments, Aquatic productivity, Thymidine, Analysis of variance, Biological properties, Diel studies, Denmark.

Particulate and dissolved organic matter in lakes is mainly decomposed by bacteria. To estimate the rates of metabolism and amounts of organic matter metabolized by aquatic bacteria, it is useful to determine bacterial production. During the last few years, several new methods have been developed, particularly those based on (H-3)thymidine incorporation into DNA. Measurements of bacterial secondary production were carried out during 13 diel studies at one coastal marine station and in five lakes differing with respect to nutrient concentration and primary production. Bacterial secondary production was measured in situ every 3 to 5 h by (H-3)thymidine incorporation into DNA. In some of the diel studies, these results were compared with results obtained from dark CO2-14 uptake and frequency of dividing cells. Only minor diel changes were observed. The rate of (H-3)thymidine incorporation into DNA and the frequency of dividing cells varied from 23 to 194% of the diel mean. The dark CO2 uptake rate varied from 12 to 259% of the diel mean. An analysis of variance demonstrated that no specific time periods during 24 h showed significantly different production rates, supporting the idea that bacterial activities in natural assemblages are controlled by a variety of events. The best correction (r sq = 0.74) was obtained between the (H-3)thymidine incorporation and frequency of dividing cells procedures from the lake water samples. The actual production rates calculated by (H-3)thymidine incorporation into DNA were appreciably lower than those obtained by the frequency of dividing cells and the dark CO2 uptake techniques. Diel rates of bacterial production are discussed in relation to sampling frequency, statistical errors, and choice of method. (Murphy-IVI)
W84-04538

MICROBIAL BIOMASS AND UTILIZATION OF DISSOLVED ORGANIC MATTER IN THE OKEFENOKEE SWAMP ECOSYSTEM,
Georgia Univ., Athens. Inst. of Ecology.
R. E. Murray, and R. E. Hodson.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 685-692, April, 1984. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Microbial biomass, *Dissolved organic matter, *Okefenokee Swamp, Aquatic ecosystem, Biological properties, Microbial degradation, Microbiological studies, Biomass, Bacteria, Food chains.

The Okefenokee Swamp exhibited levels of microbial biomass and aerobic glucose uptake comparable to those of other organically rich, detritus-based aquatic ecosystems. In contrast to other peat-accumulating systems, this acidic (pH 3.7), low-nutrient environment does not show diminished water column or surface sediment microbial biomass or heterotrophic activity. The total particular ATP varied between 0.03 and 6.6 microg/liter (mean, 1.6 microg/liter) in water and between 1 and 28 microg/g (dry weight), the mean being 10.0 microg/g(dry weight), in sediments. The turnover times for dissolved D-glucose were 1.26 to 701.25 h (mean, 110.25 h) in aerobic waters and 2.4 to 72 min (mean, 10.2 min) in aerobic surface sediments. Water column bacterial secondary production, measured as the incorporation of (H-3)thymidine into cold-trichloroacetic acid-insoluble material, ranged from 0.06 to 1.67 nmol/liter/day (mean, 0.45 nmol/liter/day). The kinetics of D-glucose uptake by water column microflora are multiphase and suggest the presence of a diverse microbial population capable of using labile substrates at nanomolar concentrations and at substantial rates. The presence of a large and active aerobic microbial community in the Okefenokee Swamp is indicative of an important role for microbes in swamp geochemistry and strongly suggests the existence of a detritus-based food web. (Author's abstract)
W84-04539

SIGNIFICANCE OF ALGAL EXCRETORY PRODUCTS FOR GROWTH OF EPILIMNETIC BACTERIA,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. D. Brock, and J. Clyne.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 731-734, April, 1984. 2 Tab, 21 Ref. NSF grant DEB-8212459.

Descriptors: *Algae, *Epilimnetic bacteria, Bacteria, Growth, Dissolved organic carbon, Aquatic ecosystems, Phytoplankton, Excretion, Growth media, Lake Mendota, Wisconsin.

Dissolved organic carbon (DOC) may serve as a primary growth substrate for free-living bacteria in aquatic systems. The DOC pool in lakes has several sources: runoff from the land, defecation by aquatic animals, lysis of plankton cells, and excretion by phytoplankton. Light-stimulated uptake of CO2-14 and differential filtration through Nucleopore filters were used to estimate the significance of phytoplankton excretion as a source of bacterial carbon in water samples collected at different seasons of the year in Lake Mendota, Wis. On an

animal basis, about 14% of the estimated bacterial production was accounted for by algal excretion, although at certain times of year the fraction of bacterial carbon derived from algal excretion was considerably higher. About 20% of the annual primary production was estimated to pass through the bacterial component. (Murphy-IVI)
W84-04540

DYNAMICS OF THE VOLATILE ORGANIC SUBSTANCES ASSOCIATED WITH CYANOBACTERIA AND ALGAE IN A EUTROPHIC SHALLOW LAKE,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juttner.
Applied and Environmental Microbiology, Vol. 47, No. 4, p 814-820, April, 1984. 6 Fig, 1 Tab, 27 Ref.

Descriptors: *Volatile organic matter, *Cyanobacteria, *Algae, Eutrophic lakes, *Dynamics, Organic matter, Chemical properties, Biological properties, Bacteria, Correlation analysis.

Volatile, low-molecular-weight organic compounds liberated by cyanobacteria and algae into surface waters are regarded as the causative agents of the odor and taste problems arising during water purification and fish breeding. The volatile substances present in a eutrophic shallow lake were determined qualitatively and quantitatively during the growing season, allowing a first-time analysis of the dynamics of these compounds in a water body. The major compounds found were beta-cyclocitral, alpha-cyclocitral, beta-ionone, 1,3,3-trimethylcyclohexene, 2,2,6-trimethylcyclohexanone, 2,6,6-trimethylcyclohex-2-en-1-one, eucalyptol, geosmin, two argosmin isomers, pent-1-en-3-ol, pent-1-en-3-one, heptadex-1-ene, heptadec-cis 5-ene, heptadeca-1, cis 8-diene, decanal, and hexanal. Most of the substances have not been detected before in natural waters. The occurrence of geosmin, the argosmin isomers, heptadec-cis 5-ene, and an unknown sesquiterpene could clearly be correlated with the appearance of Aphanizomenon gracile, as could the occurrence of beta-cyclocitral with the appearance of Microcystic wesenbergii. The data presented indicate that a rapid metabolism or the elimination of these compounds occurs in lake water. (Murphy-IVI)
W84-04541

A METHOD FOR COMPARING SCALAR IRRADIANCE MEASUREMENTS WITH UPWARD AND DOWNWARD IRRADIANCE IN LAKES,
R. H. Spigel, and C. Howard-Williams.
Water Resources Research, Vol. 20, No. 4, p 507-509, April, 1984. 5 Fig, 6 Ref.

Descriptors: *Comparison studies, *Irradiation, *Lakes, *Scalar irradiance, *Downward irradiance, *Upward irradiance, Photosynthesis, Mathematical equations, Solar radiation, New Zealand.

The distribution of solar radiation in water is one of the most important factors controlling biological and physical processes in lakes. Primary production is often limited by the light available to photosynthesizing organisms, while the depth of the wind mixed layer and the stability of the thermocline are sensitive to light extinction properties of the water. A method is outlined for comparing measurements of scalar irradiance, as measured with a 4 pi scalar irradiance meter, with downward and upward irradiance, as measured with a cosine-corrected flat plate irradiance meter. The method may prove useful when measurements of only one of these quantities are available and estimates of the other are required. The method is based on an empirical formulation of the asymptotic radiance distribution and hence is strictly valid only at the asymptotic state when the radiance distribution is symmetric about the vertical axis. In addition, some caution is needed when applying this method to lakes with high levels of suspended colloidal particles. (Murphy-IVI)
W84-04576

STOCHASTIC REPRESENTATION OF A HYPEREUTROPHIC LAKE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
C. E. Mericas, and R. F. Malone.
Journal of Environmental Engineering, Vol. 110, No. 2, p 312-324, April, 1984. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Stochastic process, *Hypereutrophic lake, Mathematical models, Eutrophication models, Vollenweider model, Lake management, Management planning, Lake morphology, Load distribution, Water quality, Lake restoration, Model studies, Crest Lake, Louisiana.

Variability in total phosphorus concentrations in a small hypereutrophic lake are represented by a stochastic modification to the basic Vollenweider model. Uncertainties arising from the definition of initial conditions and a lumped white noise parameter are used to project probability distributions of mean in-lake total phosphorus concentrations. The resulting distributions of mean phosphorus values are modified by consideration of uncertainties associated with monitoring programs to permit comparison with the monitoring results. The model is calibrated using the results of an intensive monitoring program which included nearly five hundred total phosphorus observations from Crest Lake in southeastern Louisiana. The model is also compared against the results of a routine monitoring program. Calibration results indicate the potential usefulness of this modeling approach. (Author's abstract)
W84-04595

SNAIL MARISA CORNUARIETIS IN TROPICAL HYDROELECTRIC RESERVOIRS,
World Health Organization, New York. Blue Nile Project in Sudan.
W. R. Jobin, and A. Laracuente.
Journal of Environmental Engineering, Vol. 110, No. 2, p 356-368, April, 1984. 3 Fig, 10 Tab, 3 Ref. Department of Energy contract EY-76-C-05-1883.

Descriptors: *Snails, *Marisa, *Hydroelectric reservoirs, *Tropic zone, Water quality control, Bilharzia control, Bilharzia, Schistosomiasis, Puerto Rico.

For 3 years, populations of Marisa cornuarietis, the ampullarid snail used in bilharzia control, were monitored in 28 hydroelectric and multi-purpose reservoirs in Puerto Rice to establish the habitat requirements for this biological control agent. The information can be used to estimate the fate of this ampullarid snail if it is introduced into hydroelectric reservoirs in other countries. The major factors determining habitat suitability were water temperature, the area of submerged shore which supported vegetation, and the rate or recession of the reservoir level. The ampullarid had established itself in 22 of the 28 reservoirs. (Author's abstract)
W84-04596

A PRELIMINARY INVESTIGATION OF THE RHONE RIVER PLUME IN EASTERN LAKE GENEVA,
Geneva Univ. (Switzerland). Dept. of Geology.
J. Dominik, D. Burrus, and J.-P. Vernet.
Journal of Sedimentary Petrology, Vol. 53, No. 1, p 0159-0163, March, 1983. 3 Fig, 11 Ref.

Descriptors: *Plumes, *Suspended sediments, *Rhone River, *Lake Geneva, Turbidity, Echosounder, Entrainment, Stratification, Sediment transport, Coriolis force, Water circulation.

The Rhone River entering Lake Geneva during summer stratification preserves its identity for a long distance from the river mouth. Its waters flow at the equilibrium depth determined by temperature and amount of dissolved and particulate matter. The flow path of the suspension-loaded water results from the interaction of the influx-induced circulation and Coriolis force and is modified by wind-induced lake circulation. The high concentration of particulate matter in the turbid layer at a water depth of 10 to 30 m makes the rapid determination of its areal distribution with the echosounder possible. Once identified, physical parameters of the turbid layer can be studied in detail and sampling of the suspended matter carried out in the most efficient way. This particular survey covered about 46 sq km of the lake. The depth of the reflecting horizon on the echosounder corresponds to the upper surface of the turbidity layer, and the intensity of signal depended on turbidity gradient rather than on the absolute value of the turbidity. The thickness of the turbid layer decreased with distance from the Rhone mouth. At nearly all stations the plume was well defined with steep gradients in turbidity both above and below the concentration maximum. (Baker-IVI)
W84-04605

CHEMICAL COMPOSITION OF SURFACE SEDIMENTS IN A EUTROPHIC LAKE: NAINI TAL (UP, INDIA),
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
P. K. Gupta, and M. C. Pant.
Environmental Pollution (Series B), Vol. 6, No. 2, p 95-107, 1983. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical composition, *Surface sediments, *Eutrophic lake, *Naini Tal Lake, *India, Sediments, Organic matter, Mud-water interfaces, Anoxic conditions.

Important chemical constituents (NO3-N, available P, Ca, Na, K, Mn, Cu, Zn, Co and organic matter) together with pH, Eh and clay content of surface sediments at various depths of the overlying water in Lake Naini Tal were examined during 1977-78. In addition, NH3-N and dissolved oxygen at the mud-water interface (water immediately above the sediments) were also measured. The water at the mud-water interface in deeper areas (greater than or equal to 9 m) showed almost anoxic conditions. The values of Eh, pH, NO3-N, available P, Mn, Cu, Zn and Co in the sediments showed a negative relationship with water depth and a positive relationship with dissolved oxygen at the interface. The other variables of the sediment were positively related to water depth and negatively related to dissolved oxygen at the interface. As the surface sediments in the hypolimnion were under the influence of reducing and anoxic conditions, a considerable quantity of nutrients might have been released from the sediment to the overlying water. (Author's abstract)
W84-04618

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W84-04658

DEVELOPMENT AND APPLICATION OF 'U.S.E.D.': A HYDROCLIMATE LAKE STRATIFICATION MODEL,
Salford Univ. (England). Dept. of Mathematics.
B. Henderson-Sellers.
Ecological Modelling, Vol. 21, No. 4, p 233-246, March, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Hydroclimate lake stratification model, *University of Salford eddy diffusion model, *Model studies, Hydrologic models, Thermal stratification, Thermocline, Hydroclimatology.

Two model types are currently in use to model the thermal stratification cycle in lakes and reservoirs: the eddy diffusion and the mixed layer (or integral energy) approaches. Here the former is analyzed and developments are proposed to remove the empiricisms previously implicit in these models. These discussions permit the reformulation of KHo independently of current shear, together with an expression for Ri. The deduced formulae are in good agreement with observations. The newly formulated model (the University of Salford eddy diffusion model, U.S.E.D.) is subsequently used in simulations of lakes and reservoirs at different lati-

tudes which are found to be in good agreement with observations without requiring inter-site calibration. (Author's abstract)
W84-04672

MODELLING OF MATTER CYCLE IN A MESOTROPHIC BOG ECOSYSTEM I. LINEAR ANALYSIS OF CARBON ENVIRONS,
Centre of International Projects, Moscow (USSR).
D. O. Logofet, and G. A. Alexandrov.
Ecological Modelling, Vol 21, No. 4, p 247-258, March, 1984. 1 Fig, 6 Ref.

Descriptors: *Organic matter, *Mesotrophic bog, *Linear analysis, *Carbon environs, *Model studies, Plants, Fungi, Bacteria, Litter, Animals, Cycling nutrients, Nutrient removal, Ecosystems.

By means of environ analysis the four-compartment model of matter cycle through the ecosystem of a mesotrophic bog is investigated. The aggregated compartments are: plants, animals, fungi combined with bacteria, and litter. The model is based on data obtained by observations and estimations made on the experimental area of 'Tajozhny Log' located in the southern taiga sub-zone. Environ analysis enables one to set up, in the quantitative form, certain conclusions on the relative importance of individual system components and diverse processes in the matter cycle, as well as to obtain a number of quantitative characteristics of the turnover. The whole quantity of assimilated organic matter is spent for respiration by plants (62%) and by fungi and bacteria (26%). The most part (approximately 70%) of organic matter introduced from the external environment is spent as a result of fungal and bacterial respiration. About 82% of organic matter which flows out of the litter into other compartments will return back to the litter. The organic matter of plants is expected to reside 17 years in the system before leaving it. Assimilated substances reside about 26 years in the system after assimilation. Environ analysis is discussed as a preliminary stage in developing more complex, dynamic models of the matter cycle. (Murphy-IVI)
W84-04673

MODELLING OF MATTER CYCLE IN A MESOTROPHIC BOG ECOSYSTEM, II. DYNAMIC MODEL AND ECOLOGICAL SUCCESSION,
Centre of International Projects, Moscow (USSR).
D. O. Logofet, and G. A. Alexandrov.
Ecological Modelling, Vol. 21, No. 4, p 259-276, March, 1984. 10 Fig, 12 Ref.

Descriptors: *Organic matter, *Mesotrophic bog, *Model studies, *Dynamic models, *Succession, *Ecology, Ergodic hypothesis, Ecosystems, Comparison studies, Performance evaluation.

Based upon the results of static environ analysis of the organic matter cycle through the ecosystem, a number of dynamic models are developed, in this second part, for the matter and nitrogen cycles. Probable outcomes of ecological succession are obtained within the framework of the dynamic model without using the ergodic hypothesis that is implicitly adopted in ecological studies. The probable versions of ecosystem succession under an invariable hydrological regime are, depending on the level of nitrogen nutrition, transition into the forest stage or the conservation of a transitional mesotrophic stage. The transition into a raised (oligotrophic) bog stage is hardly likely, while the transition into a eutrophic-swamp stage is quite impossible. The dynamics of both stocks in the ecosystem components and flows among them can be observed within the model in order to compare some turnover characteristics of the succession series with those of the ecological one. With this model one can observe both the dynamics of stocks in the biocenosis components and the dynamics of the intracenosis flows among them. Given the dynamics of the flows, one can calculate a dynamics of the environs by applying the (static) environ analysis on each time moment from a proper sequence of moments. (Murphy-IVI)
W84-04674

LABORATORY EVALUATION OF KINETIC PARAMETERS FOR LAKE SEDIMENT DENITRIFICATION MODELS,
Utah Water Research Lab., Logan.
J. J. Messer, and P. L. Brezonik.
Ecological Modelling, Vol. 21, No. 4, p 277-286, March, 1984. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Performance evaluation, *Kinetics, *Lake sediments, *Denitrification, *Model studies, Michaelis-Menten nitrate dependence, Arrhenius temperautre dependence, Mathematical equations, Hydrologic models, Nitrogen cycle, Lake Okeechobee, Florida.

Laboratory experiments using the acetylene blockage technique showed that denitrification rates in sediments from Lake Okeechobee, Florida, are described by Michaelis-Menten nitrate dependence and Arrhenius temperature dependence (Eact = 15.5 kcal), but do not appear to be affected by seasonal differences in the supply of carbon substrates in this eutrophic lake. Peak nitrate concentrations in the sediments are in the range of the half-saturation constant, and thus, for a given temperature, kd varies by a factor of approximately two over the typical range of nitrate concentrations. Most diagenetic sediment denitrification models employ a single-valued rate constant kd, to describe nitrate dependence. However, the use of a constant kd for eutrophic lake sediments may result in a significantly erroneous estimate of annual denitrification loss. (Author's abstract)
W84-04675

MATHEMATICAL MODELLING OF A FISH POND ECOSYSTEM,
Akademiya Nauk SSSR, Moscow. Vychislitelnyi Tsentr.
Yu. M. Svirezhev, V. P. Krysanova, and A. A. Voinov.
Ecological Modelling, Vol. 21, No. 4, p 315-337, March, 1984. 12 Fig, 4 Tab, 15 Ref.

Descriptors: *Mathematical models, *Fish ponds, Fertilizers, Nutrients, Climates, Carp, Silver carp, Bighead, Aeration, Ecosystems.

A mathematical model is constructed for a fish breeding pond for carp, silver carp and bighead. The model is a system of ordinary differential equations describing the material transformations in the ecosystem. It allows a choice of optimal regimes of the aeration, feeding and fertilization of a pond for different climatic conditions in order to maximize the yield. As a result of simulations, the dynamics of the variables that adequately reflect the real picture of the development of the ecosystem for one season are derived. The phytoplankton growth is limited by nutrients (mostly phosphorus). Fish consume a lot of zooplankton, but its concentration may increase at the beginning of the season. A lot of benthos is consumed by carp. Carp begins to gain weight at the very beginning of the season, whereas bighead and silver carp begin to grow only in July, as their growth is to a greater extent limited by temperature. Right after their application, fertilizers are quickly consumed, and the phytoplankton concentration increases. The oxygen control unit is so designed that the oxygen content never drops below 3 mg/l. The artificial aeration is increased when this threshold is passed. The amount of detritus has increased by the middle of the season, and then begins to diminish due to its uptake by bighead and silver carp. (Baker-IVI)
W84-04677

LIMNOLOGICAL STUDIES OF THE LAKES AND STREAMS OF THE UPPER QU'APPELLE RIVER SYSTEM, SASKATCHEWAN, CANADA, II. PHYTOPLANKTON PRIMARY PRODUCTION AND ALGAL SPECIES ABUNDANCE AND OCCURRENCE,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
U. T. Hammer.
Hydrobiologia, Vol. 99, No. 2, p 125-144, March, 1983. 11 Fig, 2 Tab, 37 Ref. National Research Council grant A1412.

Descriptors: *Limnology, *Qu'Appelle River, *Saskatchewan, *Canada, Primary production, Phytoplankton, Biomass, Eutrophic lakes, Species composition, Species diversity, Population density.

High phytoplankton productivity characterizes the eutrophic lakes of the upper Qu'Appelle River system. Annual primary production varied from 187 to 561 g C/sq m while daily areal production varied from 290 to 8575 mg C/sq m. The Amax range was 164 to 315 mg C/cu m/h with the highest rates usually occurring in August or September. Amax values on any given day normally occurred in the top 0.5 m. Blue-green algae (Aphanizomenon flos-aquae, Microcystic aeruginosa, Oscillatoria prolifica) dominated the phytoplankton communities during the summer and fall. Diatoms (Asterionella formosa, Fragilaria capucina, Stephanodiscus niagarae) often dominated the spring communities but sometimes persisted as dominants through the summer. Fragilaria on occasion was present at very high concentrations in the late fall. Ceratium hirundinalle was sometimes dominant but was usually an important part of the biomass. Green algae, although always present, rarely formed an important part of the biomass with Pediastrum duplex the only exception. A species list is appended. (Author's abstract)
W84-04678

DIATOMS OF SURFACE SEDIMENTS OF UTAH LAKE, UTAH, U.S.A.,
Brigham Young Univ., Provo (Utah). Dept. of Botany and Range Science.
J. A. Grimes, and S. R. Rushforth.
Hydrobiologia, Vol. 99, No. 3, p 161-174, March, 1983. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Lake sediments, *Diatoms, *Utah Lake, *Utah, Sediments, Distribution, Salinity, Nutrients, Bays.

Diatoms were examined in 57 surface sediment samples from Utah Lake. Three hundred and fifteen taxa in 43 genera were identified and quantified. Statistical analyses of the data showed that distinct geographical subregions of the lake could be delineated according to population patterns of the bottom sediment diatoms. Utah Lake is shallow and continuously mixed by wind and water currents. The diatom flora in the sediments of the lake is dominated throughout by centric species, with Cyclotella meneghiniana, Melosira granulata, Melosira granulata var. angustissima and Stephanodiscus hantzschii being the most abundant. The diatom assemblages of Provo Bay and the inner regions of Goshen Bay are unlike those of the main body of Utah Lake. The diatom assemblages of both these areas are unlike each other. Provo Bay seems to be important to Utah Lake by acting as a natural processing area for the high organic load introduced there. Goshen Bay is more saline than Provo Bay and the rest of the lake and lacks most of the cultural perturbations as well. (Baker-IVI)
W84-04679

DECAY RATES AND NITROGEN DYNAMICS OF DECOMPOSING WATERCRESS (NASTURTRIUM OFFICINALE R. BR.),
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
C. Howard-Williams, S. Pickmere, and J. Davies.
Hydrobiologia, Vol. 99, No. 3, p 207-214, March, 1983. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Nitrogen cycle, *Watercress, *Decomposition, Stream ecology, Nitrification, Nitrogen, Ammonification.

Watercress is common along streams draining fertilized pastures in the volcanic plateau of New Zealand's North Island. Its ability to grow well in these areas probably reflects relatively high levels of nitrate and phosphate in such streams, as the plant grows fast and therefore has a high nutrient demand. The decomposition of watercress in the laboratory at 10 degrees and 20 degrees C, and in the field was examined. Rates varied from 0.058 g/g/day in the laboratory to 0.115 g/g/day in the field. There was a rapid generation of particles of size < 500 microm. It is thought that washout of these from the litterbags in the field accounted for

high field decomposition rate. Formation of dissolved nitrogen compounds during decomposition followed a time series from NH4(+) to NO2 (-) to NO3 (-) with dissolved organic nitrogen accumulating at the end of decomposition. Ammonification rates were 480 and 657 g (NH4)-N/g (dry wt)/day and nitrification rates on the decomposing tissue were 640 and 571 microg (NO3)-N/g (dry wt)/day at 10 degrees and 20 degrees C respectively. Fifty-six per cent of the initial plant N was regenerated as NO 3- N, 21% as DON and 25% remained as refractory particulate N. (Murphy-IVI)
W84-04681

ZOOPLANKTON SAMPLING STRATEGIES FOR ENVIRONMENTAL STUDIES,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans, and D. W. Sells.
Hydrobiologia, Vol. 99, No. 3, p 215-223, March, 1983. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Zooplankton, *Species diversity, Species, Composition, Spatial distribution, Population dynamics, Populations, Lake Michigan.

This study characterizes sources of variation in total zooplankton abundance estimates at seven stations within the 5-10 m depth contour of southeastern Lake Michigan which were sampled monthly, April through October, for the 1975 to 1979 period. Month, year, and station were statistically significant factors affecting abundance estimates as were all interactions. Month was the largest source of variance either as a main effect or interaction. Smallest coefficients of variation were associated with subsampling (mean 6.1%) and replicate sampling (mean 15.1%). The between-station coefficient of variation averaged 39.0% and tended to be highest during the summer. For a given station and month, the between-year coefficient of variation averaged 73.4% while the between-month coefficient of variation for a single station in a given year averaged 95.1%. A table shows the estimated number of replications necessary to detect a true difference in two population means as a function of coefficient of variation. Environmental studies designed to detect spatial alterations should conduct such analyses on a cruise-by-cruise basis. Cruises should consist of a large number of stations and be conducted at least once during each season. Studies designed to detect temporal alterations require more frequent sampling because of the greater variability associated with temporal data sets. Because spatial variability adds little to the overall variability of such data sets, only a few representative stations need be sampled during each cruise. (Author's abstract)
W84-04682

ALGAL BIOASSAYS AND ALGAL GROWTH CONTROLLING FACTORS IN EUTROPHIC SHALLOW LAKES,
Station Biologique de la Tour du Valat, Arles (France).
H. L. Golterman.
Hydrobiologia, Vol. 100, p 59-64, April, 1983. 1 Fig, 3 Tab, 14 Ref.

Descriptors: *Bioassays, *Algal growth, *Eutrophic lakes, Nitrogen, Phosphate, Lake Tjeukemeer.

Bioassays with water of eutrophic Lake Tjeukemeer were carried out in the laboratory, and, in the lake itself, by placing plexiglass tubes firmly in the mud. In the laboratory nitrogen had a strong growth-promoting effect on the concentrations of chlorophyll a, N-cell and COD-cell. In the bioassays in situ nitrogen increased the concentration of chlorophyll a, but not those of cellular N and cellular COD. It is argued that chlorophyll a is not a good indicator for algal growth in bioassays and that the extrapolation of laboratory experiments where nitrogen limited algal growth - to the field situation - where light limited algal growth - often leads to erroneous results, especially in shallow eutrophic lakes. The main reason is probably that in bioassays in the laboratory the nutrient supply - both from external loading and from sediments is often different and that processes like denitrification occur in the lake, but not in the bioassays. (Author's abstract)
W84-04684

GROUNDWATER AND STREAM ECOLOGY,
Waterloo Univ. (Ontario).
H. B. N. Hynes.
Hydrobiologia, Vol. 100, p 93-99, August, 1983. 62 Ref.

Descriptors: *Ecosystems, *Groundwater, *Streams, Hyporheos, Organic matter, Absorption, Stream beds, Surface-groundwater relations, Interflow.

The functioning of running water ecosystems is considered as it applies to a more thorough consideration of the role of groundwater in stream ecology. Groundwater enters stream channels along routes that can be determined by the construction of flow nets. In reasonably porous sediments the lines of flow arrive at right angles to the perimeter of the stream. Thus shallow, possibly younger, groundwater arrives near the bank and deeper groundwater towards the middle. Any water that reaches a stream directly from the unsaturated zone, a phenomenon called interflow, does so also at the stream edge. Many studies of the hyporheal zone are cited, most dealing with physical and chemical conditions to which the hyporheos is exposed. Groundwater serves also as a source of organic matter. There have been but a few studies to data comparing the dissolved organic carbon levels in groundwater near a stream and that which actually enters the stream, and none that compares different vertical levels within the groundwater. Recent studies on the complex layer of slimes on stones, which are doubtless involved in the rapid uptake of organic matter from the water show that it occurs both above and below stones. Possibly therefore biotic complexes of this sort actually within the substratum are involved in the removal and metabolism of organic matter coming in with the groundwater. (Baker-IVI)
W84-04685

PHOSPHORUS LIMITATION IN SOME TROPICAL AFRICAN LAKES,
McGill Univ., Montreal (Quebec). Dept. of Biology.
J. Kalff.
Hydrobiologia, Vol 100, p 101-112, April, 1983. 11 Fig, 1 Tab, 47 Ref.

Descriptors: *Phosphorus, *Tropical regions, *Lakes, *Africa, *Nutrient requirements, Cycling nutrients, Lake Naivasha, Lake Oloidien, Lake Memphremagog, Lake Sonachi, Prediction, Kenya.

Two of three Kenyan lakes studied between November 1979 and October 1980 have very short (PO4)-33 turnover times, indicating a high phosphorus (P) demand throughout the year. The P turnover time in Lakes Oloidien and Sonachi is as rapid as in the most P deficient temperate zone lakes. The third lake, Lake Naivasha, has a lower overall P demand and a wide seasonal range, with lowest demand between November 1979 and February 1980 when a P deficiency was unlikely. On an annual basis the Lake Naivasha status is, however, not statistically different from that recorded during the summer in Lake Memphremagog, a generally P-limited temperate zone lake. Lake Naivasha and Lake Oloidien fit well to the line of best fit for the Dillon-Rigler relationship relating total phosphorus (TP) and chlorophyll a derived in temperate zone lakes. Thus, temperate zone models predicting aspects of lake behavior on the basis of TP may also be applicable dramatically to the fertilization of enclosures with P. However, it does not fit the TP-chla or the total nitrogen-chla plots from the temperature zone. This suggests that, in this saline lake at least, much of the TP is unavailable to the algae, with some of it in a particulate form that is readily extracted with boiling water. The epilimnetic N:P ratios also characterize lakes. Oloidien and Sonachi lakes as highly P deficient and lake Naivasha as more moderately P limited. A single set of measurements in Winam Gulf (Lake Victoria) also showed a rapid P turnover time and thus P limitation, but as in Lake Sonachi much of the TP was in a non-algal particulate form. Occasional measurements in three other hypertrophic and saline lakes suggest them to be primarily light limited on the basis of their very photosynthetic cover. These findings support the hypothesis of a primary P limitation for those lakes not light limited, and contradicts literature suggestions that nitrogen is the primary limiting element in tropical lakes. (Author's abstract)
W84-04686

LIMNOLOGY OF THE RIVER BANDAMA, IVORY COAST (LIMNOLOGIE DU FLEUVE BANDAMA, COTE D'IVOIRE),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
C. Leveque, C. Dejoux, and A. Iltis.
Hydrobiologia, Vol. 100, p 113-141, April, 1983. 23 Fig, 1 Tab, 85 Ref.

Descriptors: *Limnology, *Bandama River, *Ivory Coast, Hydrology, Chemical properties, Phytoplankton, Epiphytes, Insects, Fish, Shrimp, Ecology, Environmental impact statement, Pesticides, Dam effects, Environmental effects.

In recent years, the Bandama river and its catchment area have been subjected to intense limnological research, in the framework of a program of ecological monitoring of aquatic environment, treated with anti-simulium insecticides (W.H.O. project for Onchocerciasis control in West-Africa). The present contribution summarized the information collected on this tropical river. After a brief description of the basin and its geological setting, climatic and hydrology, results of studies on the water chemistry, biology and ecology of its animal and plant communities (plankton, periphyton, insects, decapod crustaceans, fish) are presented. The human impact on the system (dam-building, use of pesticides) is also discussed. (Author's abstract)
W84-04687

ASPECTS OF THE HISTORY AND EVOLUTION OF ALPINE LAKES IN AUSTRIA,
Vienna Univ. (Austria). Zoologisches Inst.
H. Loffler.
Hydrobiologia, Vol. 100, p 143-152, August, 1983. 4 Fig, 2 Tab, 44 Ref.

Descriptors: *Geological history, *Alpine lakes, *Austria, Eutrophication, Nutrients, Industrial wastes, Meromictic lakes, Water pollution sources, Lake restoration.

The age of lake basins, the onset of meromictic conditions and some consequences of eutrophication and reoligotrophication of Austrian Alpine lakes are presented. Apart from obviously young lake basins formed by fluviatile action, by karstic events, or by landslides, many of the natural Alpine basins are primarily tectonically preformed but utimately shaped by glacial action during the Pleistocene. Along with the retreat of glaciers, landslides and dams produced by tributaries obviously must have resulted in many transitory lakes. The first reports of lake dwellings date from the 16th century when remnants of such settlements were discovered in Lake Constance. Animal remains in sediments of holomictic lakes suggest that the distribution of the limnocytherids depended to some extent on hydrographic conditions during the Late Pleistocene. Austria has about 20 meromictic lakes. Industrial impacts and a wide variety of human influences such as forest clearing, fish stocking and the introduction of exotic species, engineering work and nutrient loading have affected the alpine lakes of Austria. Apart from possible natural eutrophication mainly just after the retreat of glaciers, nutrient loading with its consequences caused by man started in many Alpine lakes about 100 years ago. The monitoring of the Alpine lakes in Austria started after the Second World War, when trophic evolution accelerated to an alarming extent. The restoration technique used in meromictic lakes has contributed to the improvement in oxygen distribution. (Baker-IV)
W84-04688

REVIEW OF BASIC ECOLOGICAL PROCESSES INTERACTING WITH PRODUCTION AND STANDING-STOCK OF PHYTOPLANKTON IN LAKES AND RESERVOIRS IN BRAZIL,
niversidade Federal de Sao Carlos (Brazil). Lab. Limnology.
G. Tundisi.
ydrobiologia, Vol. 100, p 223-243, April, 1983. 15 g, 7 Tab, 40 Ref.

escriptors: *Phytoplankton, *Lakes, *Reservoirs, Productivity, *Cycling nutrients, *Brazil, Stratification, Environmental effects, Water level fluctuations, Limnology.

he interactions of the main forcing functions in allow lakes and reservoirs in Brazil with the nctioning of the phytoplankton community from e point of view of primary production and stand-g-stock are discussed. Forcing functions were ater level fluctuation, destratification and mixing, ind action and precipitation. One of the major ctors controlling variations in productivity and utrient availability, diurnal variations of environental factors, is also discussed. Its role in microsatification and replenishment of nutrients to the photic zone in shallow lakes is stressed. Major rocesses in reservoirs are related to residence me, 'hydraulic stratification', sediment-water teraction, and cultural eutrophication. Perspecves for future limnological research by a process-ientated approach are given. (Murphy-IVI)
784-04691

NPUT-OUTPUT BUDGETS AT LANGTJERN, SMALL ACIDIFIED LAKE IN SOUTHERN ORWAY,
orsk Inst. for Vannforskning, Oslo.
. F. Wright.
ydrobiologia, Vol. 101, No. 1/2, p 1-12, April, 983. 6 Fig, 6 Tab, 10 Ref.

escriptors: *Input-output analysis, *Langtjern ake, *Acidic lakes, *Norway, Acidic water, hemical composition, Hydrologic budget, Hyrogen ion concentration, Sulfate, Influent water.

recipitation and streamwater volume and chemial composition have been measured since 1974 at angtjern, a small, acid (pH 4.6-4.8) lake on granit-gneissic bedrock in coniferous forest located ca. 00 km north of Oslo, Norway. The area receives cid precipitation (weighted average pH 4.28). The year input-output budgets for major ions at two rrestrial subcatchments indicate that for Na, K, O4 and Cl outputs approximately equal inputs, or H+, NH4 and NO3 outputs are much less than puts, and for Ca, Mg and Al outputs greatly xceed inputs. The sulfate budgets (which include stimated dry deposit) indicate that the terrestrial atchment retains about 20% of the incoming sulte, perhaps due to absorption in the soil, plant ptake, reduction and storage in peaty areas or eduction and release of H2S to the atmosphere. he budgets for Langtjern lake itself indicate that or most components output equals inputs to ithin 10%, i.e. these compounds simply pass rough the lake. For H+, and possibly NH4 and O3, inputs exceed outputs. Because gaseous hases are not measured the N budgets are uncerin. A mechanism that leads to 'retention' of both I+ and SOP4 is sulfate reduction and incorporaon of sulfides in the lake sediments. Such has been ocumented in the experimentally-acidified Lake 23, Experimental Lakes Area, Ontario, Canada. lthough there is no evidence suggesting the deelopment of anoxic bottom waters at Langtjern, uch reduction might occur at the water-sediment terface and in the sediments. The budgets for the ollutant components H+ and SO4 at Langtjern iffer substantially from those at the relatively naffected Lake 239, in the Experimental Lakes rea. (Author's abstract)
V84-04695

ELENIUM AS A GROWTH FACTOR FOR PLANKTON ALGAE IN LABORATORY EXPERIMENTS AND IN SOME SWEDISH LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
K. Lindstrom.
Hydrobiologia, Vol. 101, No. 1/2, p 35-48, April, 1983. 6 Fig, 4 Tab, 47 Ref.

Descriptors: *Selenium, *Growth media, *Plankton algae, *Sweden, Peridinium, Stephanodiscus, Dinoflagellate, Diatom, Green algae, Calciferous lakes, Acidic lakes, Humic lakes, Bioassays, Bioavailability, Hydrogen ion concentration, Phytoplankton.

The growth requirements of inorganic and organic selenium (Se) for the dinoflagellate Peridinium cinctum fa. westii and the diatom Stephanodiscus hantzschii var. pusillus and eight species of green algae are demonstrated. A new mineral culture medium for P. cinctum is presented. Using P. cinctum as a test alga, bioassays were carried out on waters from a calciferous lake and from some acidified, fertilized, lime-enriched or humic lakes for determination of their contents of bioavailable forms of Se (bioactive Se). Some of the results were related to Tot-Se and selenite-Se, measured chemically, to pH and the occurrence of ambient phytoplankton. In calcium-rich Lake Erken (pH approximately 8) blooms and decline of algae coincided with decreases (from > 70 to approximately 20 ng Se/l) and increased (up to > 80 ng/l) of bioactive Se, indicating uptake and release of inorganic or organic forms of Se. Acidified lakes (pH < 5) generally demonstrated much lower concentrations of bioactive Se (< 20 ng/l) than neutral, fertilized, lime-enriched, slightly acidic or humic lakes (>20 ng/l). The correlation between pH and bioactive Se was positive (r approximately 0.92; n = 7). The ecological importance of Se is suggested for some common species of phytoplankton. (Author's abstract)
W84-04699

BACTERIOPLANKTON IN THE ACIDIFIED LAKE GARDSJON,
Swedish Water and Air Pollution Research Lab., Goeteborg.
For primary bibliographic entry see Field 5C.
W84-04701

RESPIRATION OF PLANKTON IN TWO SMALL, POLYHUMIC LAKES,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
K. Salonen, K. Kononen, and L. Arvola.
Hydrobiologia, Vol. 101, No. 1/2, 65-70, April, 1983. 4 Fig, 8 Ref.

Descriptors: *Respiration, *Plankton, *Polyhumic lakes, Forest hydrology, Decomposition, Mineralization, Oligotrophic lakes, Energy.

The respiration of plankton of two polyhumic lakes was measured as production of carbon dioxide dark bottles. The method proved to be enough sensitive for use in oligotrophic lakes with low alkalinity. The respiration of plankton followed broadly changes in temperature. However, the primary production of phytoplankton was probably the main factor governing the season pattern of respiration. During summer the respiration of plankton was more than three times higher than the primary production of phytoplankton. This suggests that allochthonous humic substances are an important source of carbon and energy for organisms of polyhumic lakes. (Author's abstract)
W84-04702

SEASONAL DEVELOPMENT OF BACTERIOPLANKTON IN TWO FOREST LAKES IN CENTRAL SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
J. A. Johansson.
Hydrobiologia, Vol. 101, No. 1/2, p 71-88, April, 1983. 9 Fig, 8 Tab, 51 Ref.

Descriptors: *Seasonal variation, *Bacterioplankton, *Forest lakes, *Sweden, Bacteria, Productivity, Biomass, Growth rates, Energy.

Bacteria were counted with acridine orange epifluorescence technique in two humic lakes during 3 years. Less than 1% of the cells were found attached to detritus aggregates. 73% of the total number of 48% of the total volume were smaller than 1 micro m. The mean cell volume ranged from 0.10 to 0.35 micro cu m with the highest cell volumes occurring during early summer contemporarily with the growth of the bacterial biomass and probably indicating favourable growth conditions. The mean density of bacteria in oligotrophic brown-water lakes is higher than in oligotrophic clear-water lakes. The development of bacterial biomass showed a regular and seasonally dependent pattern with maxima during early summer and autumn. The importance of different factors for the regulation of bacterial biomass is discussed. Three different approaches were used to estimate bacterial production. These resulted in an average production rate of 15-60 micro g C/l/d during the growing season. It was concluded that allochthonous sources comprised a significant part of the energy supply to the bacteria in the two humic lakes. (Author's abstract)
W84-04703

RELATIONS BETWEEN PRODUCTION AND BIOMASS OF PHYTOPLANKTON IN FOUR SWEDISH LAKES OF DIFFERENT TROPHIC STATUS AND HUMIC CONTENT,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Heyman.
Hydrobiologia, Vol. 101, No. 1/2, p 89-104, April, 1983. 3 Fig, 6 Tab, 27 Ref.

Descriptors: *Productivity, *Biomass, *Phytoplankton, *Sweden, *Lakes, *Trophic level, Growth rates, Growth equation.

Production and biomass values from phytoplankton populations in four different Swedish lakes were analyzed. The production in all lakes was directly proportional to biomass during homothermal periods. When the lakes were stratified there was a strong negative relation between specific growth rate and biomass. The data fitted to a logistic density dependent growth equation of the form: dB/dt = micro sub m B(1-B/K) where B is the biomass, micro sub m the maximum specific growth rate and K the carrying capacity. The equation was used to derive the parameters micro/micro sub m and carrying capacity (the maximum possible biomass). These parameters were then discussed in relation to light climate, phosphorus concentration and humic content. (Author's abstract)
W84-04704

PRIMARY PRODUCTION AND PHYTOPLANKTON IN TWO SMALL, POLYHUMIC FOREST LAKES IN SOUTHERN FINLAND,
Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola.
Hydrobiologia, Vol. 101, No. 1/2, p 105-110, April, 1983. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Lakes, *Finland, Polyhumic lakes, Ecosystems, Forest hydrology, Chlamydomonas, Mallomonas, Chlorophyta.

Primary production and phytoplankton in polyhumic lakes showed a very distinct seasonal succession. A vigorous spring maximum produced by Chlamydomonas green algae at the beginning of the growing season and two summer maxima composed mainly of Mallomonas caudata Iwanoff were typical. The annual primary production was about 6 g org C/sq m in both lakes. The mean epilimnetic biomass was 1.1 in the first and 2.2 g/sq m in the second lake. The maximum phytoplankton biomass, 14 g/sq m was observed during the vernal peak in May. The growing season of phytoplankton in the lakes under study began before the lakes were ice-free because light, which is the minimum factor during winter, could penetrate the ice as soon as snow melted. After the spring maximum, dissolved inorganic nutrient concentrations were very low, and in June Uroglena and Dinobryon

species were the most common in phytoplankton communities. The summer maximum began to develop at the beginning of July, and was composed mainly of Mallomonas caudata in both lakes. During the period of growth various factors control phytoplankton succession and primary production in the lakes studied. Light, nutrients, temperature and flushing seem to be the main factors which affect phytoplankton community and productivity. (Baker-IVI)
W84-04705

ZOOPLANKTIC INDICATORS OF TROPHY AND THEIR FOOD,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
B. Pejler.
Hydrobiologia, Vol. 101, No. 1/2, p 111-114, April, 1983. 1 Tab, 47 Ref.

Descriptors: *Oligotrophic lakes, *Zooplankton, Trophic level, Eutrophication, Sweden, Subarctic zones, Bioindicators, Bacteria, Rotifers.

An analysis was performed concerning the food of oligotrophic as well as eutrophic indicators in order to characterize the specific food requirements of zooplankters in oligotrophic forest lakes. In connection with an increasing trophic degree specialists on small-particle feeding are favored and macrofiltrators disfavored. Consequently, a successively larger fraction of the food will consist of bacteria. Survivors in hypertrophic lakes thus mostly consist of high-efficiency bacteria feeders and of raptorial forms. In the extremely poor, ultraoligotrophic lakes, the number of steps of the ecological pyramid should be relatively small, and all zooplankters could be conceived to be herbivorous. In the rotifer community only suspension feeders were found in all investigated arctic lakes of northern Sweden. Most subarctic lakes contained two or more such species and one case contained five. (Baker-IVI)
W84-04706

GROWTH AND FEEDING OF FREDERICELLA SULTANA (BRYOZOA) IN THE OUTLET OF A HUMIC ACID LAKE,
Bergen Univ. (Norway). Zoological Museum.
G. G. Raddum, and T. M. Johnsen.
Hydrobiologia, Vol. 101, No. 1/2, p 115-120, April, 1983. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Humic acids, *Bryozoa, *Fredericella, *Lake Ulsetstemma, *Norway, Growth, Feeding, Eutrophication, Algae, Nutrients, Phytoplankton, Hydrogen ion concentration, Biomass.

In the period July 1970-October 1972 sampling and observations of F. sultana were carried out every second week during the growing season and once a month during winter. Ionic content and pH found in Lake Ulsetstemma were typical for lakes situated in forest areas in Norway. The water was humic with color ranging betwen 25 and 143 mg Pt/l, pH between 5.0-6.0, conductivity between 25-60 microS/cm and Ca in the range of 0.8-2.1 mg/l. The content of particulate organic matter was usually less than 5 mg/l but values up to 11 mg/l were measured. F. sultana species was able to stay in humic water with pH down to 5.0. In absence of predation F. sultana can build up great biomass utilizing the drift of nutrition from the water body. During algal blooms and suitable temperature the animals have rapid growth rate feeding on particle sizes from the smallest up to about 240 micro m in length. The width of the particles, however, cannot be greater than the mouth opening. As F. sultana has a very poor digestion the animal has to maintain a high turnover of nutrition particles. Colonies in rapid growth may therefore play an important role regarding breakdown and recycling of nutrition in the freshwater ecosystem as well as structuring the phytoplankton community by the selective feeding observed. (Baker-IVI)
W84-04707

THE FOOD PREFERENCE OF VENDACE (COREGONUS ALBULA) IN SOUTH SWEDISH FOREST LAKES INCLUDING THE PREDATION EFFECT ON ZOOPLANKTON POPULATIONS,
Lund Univ. (Sweden). Limnological Inst.
S. F. Hamrin.
Hydrobiologia, Vol. 101, No. 1/2, p 121-128, April, 1983. 5 Fig, 4 Tab, 30 Ref.

Descriptors: *Oligotrophic lakes, *Zooplankton, *Lake Bolmen, *Sweden, *Vendace, Forest lakes, Predation, Fish food, Bacteria, Aquatic animals, Fish, Crustaceans.

Lake Bolmen is an oligotrophic lake situated in the southwestern part of Sweden. The lake has three basins of which the biggest, used for this study, has a maximum depth of 37m. Thermal stratification takes place at depths between 10 and 20 m during summer. The fish fauna is dominated by vendace and perch. Vendace is the most common fish species in Lake Bolmen. The population, which is strongly dominated by age class 0+, exhibits cyclic population oscillations with a strong year class every second year. The pelagic crustacean fauna in vendace lakes is dominated by small species like Bosmina coregoni, Daphnia cristata, Thermocyclops and Mesocyclops sp. and Eudiaptomus sp. During periods of maximum vendace abundance only Bosmina coregoi is left of the cladocerans, while the abundance of cyclopoid copepods increases. (Baker-IVI)
W84-04708

NUTRIENT AND OXYGEN REDISTRIBUTION DURING DESTRATIFICATION IN THE ELEFSIS BAY, AN ANOXIC BASIN,
Institute of Oceanographic and Fisheries Research, Athens (Greece).
N. Friligos.
Hydrobiologia, Vol. 101, No. 3, p 223-230, May, 1983. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Nutrients, *Oxygen balance, *Destratification, *Elefsis bay, Mixing, Oxygen, Phosphate, Silicate, Ammonia, Cycling nutrients.

Destratification in Elefsis Bay due to winter cooling, heavy water formation and mechanical mixing produces homogenous water column that is moderately stratified during the summer as a result of surface heating and reduced mechanical mixing. In the Elefsis Bay, this destratification redistributes ammonia, phosphate and silicate regenerated by the organic matter as well as oxygen from the surface. This redistribution has significant implications for nutrient cycles and organism distribution in the Bay. Reasons for the increase of the phosphate concentrations through release of P from the sediments and the conversion of nitrate to nitrogen gas in oxygen-deficient water have been confirmed. The relation between the accumulation of phosphate, silicate and ammonia are discussed. (Author's abstract)
W84-04713

AN IMPROVED ENVIRONMENTAL INDEX BASED ON THE RELATIVE ABUNDANCE OF OLIGOCHAETE SPECIES,
Institute of Freshwater Research, Drottningholm (Sweden).
G. Milbrink.
Hydrobiologia, Vol. 102, No. 2, p 89-97, June, 1983. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Environmental index, *Oligochaetes, Species diversity, Equilibrium state, Shannon-Weaver index, Simpson's index, Comparison studies, Population density.

Howmiller and Scott presented an 'Environmental Index' based on thorough knowledge of the ecological demands of species of freshwater oligochaetes frequently found in North American waters. These authors emphasized the fact that common diversity measures do not utilize information about the ecological attributes of the constituent species but rather about community structure. A modification of the 'Environmental Index' is here presented with the aim of increasing its sensitivity in Europe and possibly also in North America. Four ecological groups are here preferred to the original three, and the ecological valence of the 'key-species' Tubifex is discussed at some length. Whereas most environmental and diversity indices remain little affected by changes in the total abundance of oligochaetes, the modified index is sensitive to such changes. Comparisons are made with two of the most popular diversity indices applied to specific situations, i.e. the Shannon-Weaver index and Simpson's index. In spite of recommendation in pollution manuals, indices of diversity may be inadequate in correctly characterizing situations of nutrient enrichment of freshwater environments. In the present study it is stressed that low diversity is usually found at both ends of the trophic scale and high diversity, which is supposed to characterize a clean and unstressed environment, is generally obtained in zones of transit between oligotrophic and eutrophic conditions - a likely result of the 'nonequilibrium state' described by Connell (1978) from coral reefs and rain forests in the tropics. (Author's abstract)
W84-04718

FUNGI AND BACTERIA ASSOCIATED WITH PINE (PINUS KESIYA ROYLE) NEEDLES AND TEAK (TECTONA GRANDIS L.) LEAF LITTERS DURING PROCESSING IN A FRESHWATER LAKE,
North-Eastern Hill Univ., Shillong (India). Dept. of Botany.
R. R. Mishra, and B. K. Tiwari.
Hydrobiologia, Vol. 102, No. 2, p 123-129, June, 1983. 3 Fig, 3 Tab, 28 Ref.

Descriptors: *Fungi, *Bacteria, *Pinus, *Tectona, *Freshwater lakes, Litter, Population density, Species composition, Decomposition, Chemical properties, Physical properties, Organic matter.

The process of decomposition is extremely complex and is controlled by a multitude of organisms, by the chemical and physical properties of the litter and by the abiotic environment. Pinus kesiya Royle needles and Tectona grandis L. leaves were exposed in a freshwater lake at three stations and at different depths for a period of 600 days using plastic net bags (1 mm pore size). The fungal and bacterial populations associated with the two litters were estimated at periodic intervals. Rapid initial colonization (up to 100 days) and a lowering of populations after 200-300 days, followed by another peak after 400-500 days were noted. Both fungi and bacteria followed almost similar trends of population variation. Litter at the shallow stations harbored more fungi and bacteria. The species composition of fungi varied with time. The possible role of terrestrial fungi in aquatic habitats is discussed. (Murphy-IVI)
W84-04720

MICROBIOLOGICAL DESCRIPTION OF THE KIEV RESERVOIR IN THE 13TH TO 14TH YEARS OF ITS EXISTENCE,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
L. E. Mikhaylenko, T. V. Golovko, and E. I. Dukhovnaya.
Hydrobiological Journal, Vol. 19, No. 2, 1983. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Microbiological studies, *Bacteria, *Kiev reservoir, *USSR, Dam effects, Postimpoundment, Reservoirs, Biomass, Nutrients, Plankton, Zooplankton, Productivity.

The Kiev reservoir, impounded in 1965, is located on the upper reaches of the Dnepr, 30 km above Kiev (USSR). Its water has a high color, relatively high concentration of iron (0.200 to 0.320 mg/l), and a low phosphorus content (0.01 to 0.02 mg/l). A multiyear study of the bacterioplankton dynamics in the Kiev reservoir showed a 'flooding effect' in the first three years, with a spurt in bacterial numbers as a result of mineralization of organic matter accumulated in the flooded zone. The microbiology of the reservoir has remained stable since 5 to 6 years after its damming. Bacterioplankton counts are now lower than immediately after damming or before regulation of the river. The bacterial population in the reservoir has stabilized not because of lesser availability of food but be-

cause of regulation by zooplankton, which now consumes more bacteria, as well as because of lower reproduction rate of the bacteria. This reproduction rate has declined to the point that the average generation lifetime is now 60 hr, compared to 24 hr in 1965 to 1967. The reservoir has become mesotrophic. (Moore-IVI)
W84-04722

DISTRIBUTION AND PRODUCTION OF MACROPHYTES IN SMALL LAKES OF CENTRAL KARELIA,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
E. A. Klyukina, and K. V. Freyndling.
Hydrobiological Journal, Vol. 19, No. 2, p 27-31, 1983. 4 Tab, 7 Ref.

Descriptors: *Lakes, *Macrophytes, *Karelia, *USSR, Aquatic plants, Littoral zones, Transparency, Plant growth, Acidity, Salinity, Biomass, Primary productivity.

Data are given on the mode and level of macrophyte overgrowth of seven small lakes surrounding the Segozero reservoir in Central Karelia. The macrophyte distribution in various lakes is analyzed as a function of the littoral zone development, water transparency, pH, and salinity. Estimates of annual macrophyte production in the lakes, their energy equivalents, and importance in the organic and mineral balance are presented. The lakes can be divided into two groups based on their plants. In the four lakes where helophytes were dominant, they accounted for most of the plant production. The lowest quantity of organic carbon per sq m (0.6 g) of lake surface is released by dying macrophytes in Sukkozero, and highest (5.1 g) in Lake Torosyarvi. The importance of macrophytes in the balance of organic and inorganic matter in the lakes was estimated on the basis of chemical analysis of the plants and the reserves of phytomass. A definite quantity of various substances is accumulated annually as a result of metabolic activity in the aerial part of macrophytes. A large part of this matter reenters the lakes upon death of these plants. The largest quantity of these substances reenters Syargozero and the smallest reenters Lake Torosyarvi. The area of overgrowth of these lakes depends on their morphology, hydrology, and hydrochemistry. The magnitude of primary production of macrophytes in turn, depends on the plant overgrowth area. Macrophytes are moderately well developed in all these lakes investigated and may promote fish breeding should the small lakes of the Segozero group be used for this purpose in the future. (Baker-IVI)
W84-04723

EUTROPHICATION OF THE MACROPHYTE OVERGROWN LAKES,
Akademiya Nauk SSSR, Moscow. Inst. Geografii.
T. N. Pokrovskaya.
Hydrobiologia, Vol. 19, No. 3, p 12-18, 1983. 6 Fig, 11 Ref.

Descriptors: *Eutrophication, *Macrophytes, *Eutrophic lakes, Phytoplankton, Blooms, Cycling nutrients, Bioassays, Organic matter, Photosynthesis, Bioaccumulation.

The eutrophication of lakes is generally assumed to be ralated with the productive activity of phytoplankton. The quantities and rates of photosynthesis of such plankton are considered to be most important characteristics of the trophicity of a lake, and thus of the level of its eutrophication. However, it is also known that eutrophication is not produce by phytoplankton alone. It is often due to the activity of submerged macrophytes, which not only produce organic matter, but also are important regulators of the nutrient cycles in such lakes. The functioning of macrophyte-overgrown lakes precludes phytoplankton blooms not only under natural conditions but also when the nutrient load is increased by pollution. Only very large nutrient overloads cause complete failure of the system, at which point phytoplankton becomes a major organic-matter producer in the lake. The failure comes on gradually. Its extent can be estimated from the phytocenotic conditions in submerged plants, i.e., their qualitative and quantitative composition, productivity and nutrient availability, as determined by tissue analysis. (Murphy-IVI)
W84-04728

COMPARISON OF FUNCTIONING OF PLANKTONIC COMMUNITIES IN ENCLOSED AND OPEN PARTS OF A RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. I. Shcherbak, A. I. Denisova, G. A. Zhdanova, T. V. Golovko, and V. S. Fedak.
Hydrobiologia, Vol. 19, No. 3, p 19-25, 1983. 7 Fig, 16 Ref.

Descriptors: *Comparison studies, *Functioning, *Plankton communities, Enclosed reservoirs, Open reservoirs, Hydrobiology, Reservoirs, Chemical properties, Phytoplankton, Bacterioplankton, Zooplankton, Population dynamics, Kiev reservoir.

The present objective was to explore the possibility of using closed (isolated) parts of reservoirs for hydrochemical and hydrobiological studies, to investigate the effect of isolation on the functioning of the planktonic communities. The thermal and hydrochemical (O2, O-3, PO4, Fe+2 + Fe+3 concentrations) indices of an enclosed and open part of the Kiev reservoir are compared. The quantitative and qualitative compositions of bacterio-, phyto- and zooplankton were determined, and the phyto- and bacterioplankton production was estimated. Isolation of relatively large areas of a reservoir for a few months has no significant effect on the development of various components of the plankton. This allows for long-term experiments on the structure and functioning of the planktonic communities for the purpose of understanding the effects of factors such as the concentrations of nutrients, fungicides, toxicants, allochtonic and other substances under the conditions with maximum similarity to natural ones. (Murphy-IVI)
W84-04729

ZOOPLANKTON AND FEEDING OF YOUNG FISH IN THE ZONE OF DISCHARGE OF EFFLUENTS FROM THE TRIPOL'YE POWER PLANT,
Tikhookeanskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistava i Okeanograffii, Vladivostok (USSR).
For primary bibliographic entry see Field 5C.
W84-04731

BACTERIA ON VASCULAR AQUATIC PLANTS,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. M. Kudryavtsev.
Hydrobiologia, Vol. 19, No. 3, p 50-55, 1983. 4 Tab, 12 Ref.

Descriptors: *Bacteria, *Vascular aquatic plants, *Aquatic plants, Population dynamics, Macrophytes, Littoral zone, Rybinsk reservoir, Decomposition, Biomass, Fouling, Cycling nutrients, Assimilative capacity.

Microorganisms that are part of the periphytonic communities are important in biological recycling of matter. The dynamics of development, total number and physiological groups of bacteria were determined in the communities fouling the macrophytes of the southern littoral zone of the Rybinsk reservoir. The total number of bacteria (counted directly) ranged from 3 to 4 million/sq cm. The rate of hetrotrophic carbon dioxide assimilation by the bacteria ranged between 0.03 and 1.61 million mocro g C/sq cm/day. The output of bacterial biomass was in the range of 0.5 to 26.8 micro g C/sq cm per day. The fouling community contains large numbers of bacteria capable of growing on RPA, fungi, Azotobacter, as well as starch- and cellulose-decomposing bacteria. (Murphy-IVI)
W84-04733

FISH FRY IN BEDS OF AERIAL-AQUATIC PLANTS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. L. Dolinskiy.
Hydrobiologia, Vol. 19, No. 3, p 86-91, 1983. 3 Tab, 13 Ref.

Descriptors: *Aquatic plants, *Fish fry, Growth, Fish diets, Biocenosis, Species composition, Population dynamics, Seasonal variaton, Water Mannagrass, Lesser reedmace, Common reed, Dnieper reservoirs.

Seasonal dynamics of fish fry inhabiting the biocenoses of aerial-aquatic plants of the Dnieper reservoirs have been studied by means of a buoyant net. The water-manna-grass, reedmace and reed beds were found to contain 23 species of fry. Reed beds exhibit the greatest species diversity, and water manna-grass beds the lowest diversity. The ichthyofaunas of the manna-grass and reedmace coenoses exhibit the highest commonality of species. Roach, rudd, white bream, Verkhovka, bleak, bitterling occur most often. Data on numbers and biomass are presented for the fry inhabiting the beds. (Author's abstract)
W84-04735

ECOLOGY OF LEMBADION BULLINUM PERTY AND LEMBADION LUCENS MASKELL,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Koval'chuk, and I. Ergashboyev.
Hydrobiologia, Vol. 19, No. 3, p 92-95, 1983. 1 Tab, 32 Ref.

Descriptors: *Ecology, *Lembadion, Decomposition, Organic matter, Self-purification, Species diversity, Hydrobiology.

Information on the ecological characteristics of the individual species of freshwater free-swimming Infusoria is needed for a more accurate determination of the indicator potential of the Infusoria, their role in the processes of the production and decompositon of organic matter in water, and also for their culture on a large scale. An ecological description of Lembadion bullinum Perty and Lembadion lucens Maskell, based on data available in literature and obtained by the authors in the Kiev and Nurek reservoirs (which differ in their typological, hydrological and hydrobiological properties) is presented. Both species have an ecological spectrum in terms of production, organic matter decomposition and saprobic index. The main factors influencing the development of the species are similar, yet L. bullinum is more important in self-purification and production of organic substances in the two reservoirs. (Murphy-IVI)
W84-04736

BIOGENIC REGULATION OF IRON AVAILABILITY IN A EUTROPHIC HARDWATER LAKE,
National Water Research Inst., Burlington (Ontario).
T. P. Murphy, K. J. Hall, and I. Yesaki.
The Science of the Total Environment, Vol. 28, p 37-50, June, 1983. 9 Fig, 18 Ref. National Science and Engineering Research Council grant 67-8935.

Descriptors: *Iron, *Eutrophic lakes, *Biogenic regulation, British Columbia, Phytoplankton, Eutrophication, Algal growth, Aphanizomenon, Anabaena, Iron availability.

Iron availability influenced phytoplankton growth in a naturally eutrophic hardwater lake in British Columbia. Early in the summer the algal biomass (< 15 micro g Chl a/L) was low relative to the phosphorus supply (> 250 micro g/L). The Aphanizomenon blooms (80-150 micro g Chl a/L) did not develop until the Anabaena had died and the iron concentration had increased. Prior to the Aphanizomenon blooms, iron or chelator enrichment of bioassays stimulated algal growth. Most of the epilimnetic iron was particulate. The iron binding capacity of the water was weak but low molec-

ular weight iron chelators were metabolized rapidly. The influence of iron on algal growth was related to limited iron availability and not necessarily to low iron concentrations. Some of the algal community structure was probably determined by iron availability. (Author's abstract)
W84-04739

VITAMIN ENRICHMENT OF LAKE PLANKTON: FIELD TESTS OF MICRONUTRIENT LIMITATION,
Ottawa Univ. (Ontario). Dept. of Biology.
D. K. Smith, T. Mousseau, and F. Briand.
Archiv fur Hydrobiologie, Vol. 99, No. 4, p 433-442, March, 1984. 1 Fig, 2 Tab, 40 Ref.

Descriptors: *Vitamins, *Phytoplankton, *Heney Lake, *Quebec, Algal growth, Algae, Lakes, Nutrients, Thiamine, Vitamin B-12, Biomass.

Levels of biotin, B-12, and thiamine, were experimentally increased in twelve enclosures suspended in Heney Lake, Quebec, to test whether ambient vitamin levels are limiting to lake phytoplankton. A total of 78 phytoplankton species were recorded over the course of study, including 32 green algae, 21 diatoms, 16 blue-greens and 9 species belonging to other taxonomic groups. Only four species were significantly affected: the blue-greens Aphanocapse and Lyngbya contorta, the green Mougeotia and the diatom Synedra delicatissima. All registered a significant reduction in biomass, which followed the addition of thiamine in the case of Aphanocapsa, and of biotin for the others. L. contorta and S. delicatissima were also reduced by the multiple enrichment, which constituted the only response to that treatment. This constitutes the first direct evidence that vitamin levels are sufficient to meet algal requirements in lakes. (Baker-IV)
W84-04752

A VERSATILE COMPUTER-CONTROLLED TRACKING AND SAMPLING SYSTEM FOR USE WITH MODEL LAKES IN TALL TUBES,
Edinburgh Univ. (Scotland). Grant Inst. of Geology.
M. M. Gibbs, F. R. Ohnstad, and C. R. Cunningham.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 489-497, 1984. 5 Fig, 11 Ref.

Descriptors: *Automation, *Model studies, *Lakes, Computers, Monitoring, Simulation, Data acquisition.

The tall-tube experimental system makes it possible to study an organism or physico-chemical feature of a lake under prescribed conditions with the replications and controls that normally cannot be found in a lake. A computer-controlled tracking system for experimental tubes which simulate lake conditions offers considerable advantages over other systems. It is simple to use and can be readily repositioned for use in different tubes when several simultaneous experiments are being run. Because the probe cable is retained in the apparatus body it is kept free from tangling and is less likely to become contaminated. Once programmed for an experiment it will run identical replicate profiles, thus improving the reliability of the final results. The computer which controls the tracking system is available to receive, process and store data during each profile, thus eliminating the need for several chart recorders and the operator time spent decoding their traces. The system can be left to collect data as programmed with minimal supervision unless discrete samples are also required. The data is stored in a form that can be easily manipulated into statistical analyses without introducing data transfer errors. (Moore-IVI)
W84-04755

NANOPLANKTON: CHIEF PRIMARY PRODUCERS IN LAKE NAINITAL,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
M. C. Pant, and A. P. Sharma.
Current Science, Vol. 52, No. 15, p 739-741, August 5, 1983. 1 Fig, 15 Ref.

Descriptors: *Nanoplankton, *Primary productivity, *India, *Lake Nainital, Plankton, Phytoplankton, Biomass, Algae, Eutrophic lakes.

The contribution of nanoplankton to total phytoplankton biomass production in Lake Nainital was measured. Nanoplankters (10-20 micron size class in particular) which dominatd the phytoplankton community in terms of standing stock were the main producers of organic matter in the lake. The dominance of these organisms in this eutrophic lake is a limnological paradox. Generally these organisms are abundant in nutrient poor wastes where they materially affect the absorption of nutrients and their subsequent transfer to the higher trophic levels. In eutrophic lakes, the phytoplankton succession culminated into a bloom of blue-green algae and nanoplankton becomes a poor component of the system. However, in this study the eutrophic natures of the water body, i.e. the restricted light penetration, high detritus content and community metabolism, appears to be conducive to greater growth and activity of these organisms. (Baker-IVI)
W84-04758

PLANKTONIC COMMUNITIES IN FLORIDA SOFTWATER LAKES OF VARYING PH,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. L. Brezonik, T. L. Crisman, and R. L. Schulze.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 46-56, January, 1984. 8 Fig, 3 Tab, 44 Ref. EPA grant 805560.

Descriptors: *Plankton, *Florida, *Softwater lakes, *Hydrogen ion concentration, Chlorophyta, Cyanophyta, Phosphorus, Phytoplankton, Zooplankton, Species diversity, Productivity.

In 20 softwater Florida lakes (pH range 4.7-6.8), phytoplankton diversity was significantly higher in the less acidic lakes; mean numbers of species in two groups (1, pH $<$ 5.3; 2, pH $>$ 5.6), each consisting of 10 lakes, was 10.8 and 16.5, respectively. Blue-green algae were dominant in less acidic lakes, while green algae were the most common group in acidic lakes. Phytoplankton abundance also was lower in acidic lakes, but covariation of phosphorus concentrations with pH confounded interpretation. Trends in zooplankton communities along the pH gradient were less pronounced. More acidic lakes had more species than the less acidic lakes, but three measures of species diversity showed no significant differences between the two groups. Zooplankton abundance was lower in the acidic lakes, but the relationship between abundance and pH showed much scatter. Lake productivity probably affects zooplankton abundance more than pH does in the sample group. No clear trends were observed in relative abundance of major zooplankton groups across the pH gradient. Six acid-tolerant species (including Diaptomus floridanus, Eubosmina tubicen, and Daphnia ambigua) were dominant in all 20 lakes. (Author's abstract)
W84-04759

LAKE MIXING AND ITS RELATIONSHIP TO EPILIMNETIC PHOSPHORUS IN SHAGAWA LAKE, MINNESOTA,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer, and D. E. Armstrong.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 57-69, January, 1984. 6 Fig, 6 Tab, 16 Ref. EPA grant R-805281.

Descriptors: *Mixing, *Shagawa Lake, *Minnesota, Epilimnion, Phosphorus, Eddy conductivity, Thermal stratification, Wind, Lake basins, Climate, Density currents.

Using thermometry, the mixing regime was intensively studied in each of the two principal basins of Shagawa Lake. After the thermocline had migrated past the interbasin sill depth (6m), it migrated more rapidly in the larger, windswept western basin that in the smaller, sheltered eastern basin. The metalimnetic eddy conductivities (Kz) were also larger in the west basin, ranging from 0.025 sq cm/s during intervals of low wind energy up to 0.25 sq cm/s during intervals bracketing powerful cold fronts. The bottom temperature increased rapidly in the west basin in response to mixing, reducing total water column stability and inceasing susceptibility to a sudden 'turnover.' Because of these warm bottom temperatures and drainage basin influence, density currents sometimes carry cold water into the benthic zone of the west basin following heavy, cold rains in midsummer. Epilimnetic phosphorus concentrations in Shagawa Lake depend on linkages among weather, basin morphometry, and water column redox. Time series analysis of 8 yr of record reveals the special importance of two factors. First, the anoxic zone below the mixed layer must include an important fraction of the metalimnetic shelf sediments in the western basin (6-10m zone). Second, the mixed layer must migrate downward and directly entrain water overlying the anoxic sediments. Time series analysis excludes the possibility of sediment release of phosphorus within the epilimnetic zone as the principal control on phosphorus in the pelagic mixed layer. For lakes with similar morphometry and climatic setting, and a previous history of sewage inputs, lake mixing complicates the trophic adjustment of the lake to a reduction in external phosphorus loading. (Author's abstract)
W84-04760

ORTHOPHOSPHATE UPTAKE RATE CONSTANTS ARE MEDIATED BY THE 10(3)-10(4) MOLECULAR WEIGHT FRACTION IN SHIELD LAKE WATER,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. Brassard, and J. C. Auclair.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 166-173, January, 1984. 3 Fig, 2 Tab, 40 Ref, 1 Append.

Descriptors: *Shield lakes, *Orthophosphates, Phytoplankton, Phosphorus radioisotopes, Uptake, Phosphates, Seston, Plant physiology, Chlorophyll, Lakes.

Midsummer chlorophyll concentrations can be predicted from total phosphorus at spring overturn for a number of North American lakes, but attempts to identify all bioavailable phosphorus compounds has proven difficult. Inconsistencies in determining colloidal phosphorus utilization and the discovery that orthophosphate concentration and flux are poor predictors of lake trophic status indicate that other forms of phosphorus compounds, which may not be necessarily labeled over the radioisotopic uptake assay (P-32) period, are assimilated by natural phytoplankton assemblages. Ultrafiltration methodology was used to test the hypothesis that the orthophosphate uptake rate constant can be physiologically varied upon changing the external concentration of selected molecular weight fractions in Shield lake waters. Experiments were carried out with water from lac Tantarie, an acidic and oligotrophic Shield lake located 42 km north of Quebec City. The fraction between molecular weight 1000 and 10000 significantly increased the orthophosphate uptake rate constant when exposed to the natural seston. This suggests that the orthophosphate uptake rate constant is subject to fluctuations depending on the availability of low molecular weight phosphorus metabolites in the external solution. The physiological basis of these observations may be a metabolic coupling between the activity of plasmalemma-bound phosphatases and the transport of PO4(3-) across the cell membrane. (Moore-IVI)
W84-04763

TRANSPORT OF DISSOLVED ORGANIC CARBON, NUTRIENTS, AND TRACE METALS FROM THE WILSON AND BLOSSOM RIVERS TO SMEATON BAY, SOUTHEAST ALASKA,
Alaska Univ., Fairbanks. Inst. of Marine Science.
S. F. Sugai, and D. C. Burrell.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 180-190, January, 1984. 7 Fig, 5 Tab, 38 Ref. DOE contract E(45-1)-2229.

Descriptors: *Nutrients, *Organic carbon, *Trace metals, *Wilson river, *Blossom River, *Alaska,

Solute transport, Salmon, Copper, Iron, Manganese, Muskeg, Metals.

Increasing development poses an immediate threat to the salmon fisheries of southeast Alaska. Regional and seasonal differences in chemical input from the Wilson and Blossom rivers, two pristine, major salmon-producing rivers in southeast Alaska, were examined in order to determine possible restraints on productivity and to examine transport mechanisms of potential toxicants. Concentrations of dissolved organic carbon, nutrients, Cu, Fe, and Mn in the rivers were determined at approximately monthly intervals for a period of two years, and used to calculate export rates. Because of extremely high annual precipitation (400-450 cm) and drainage basins restricted by high topographical relief, the concentrations and export rates of nutrients and Cu are low in the rivers for most of the year. The maximum nutrient export from the Wilson-Blossom system appears to be closely tied to the annual salmon cycle. The decomposition of spawned salmon is the most likely explanation for observed nutrient peaks. Iron and Mn export rates from the watersheds are much high than those for Cu, reflecting solubilization of Fe and Mn under reducing conditions that develop in muskeg ponds during drought periods. The association of metals with organics allows transport of Fe and possibly other metals throughout the fjord system, in contrast with the large-scale removel of metals in or near the river's mouth, as has been observed elsewhere. (Moore-IVI)
W84-04764

APPLYING INFORMATION THEORY TO ANAYSIS OF CATCH DYNAMICS OF FISH IN INCIPIENT ECOSYSTEMS,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
M. M. Smetanin, A. S. Strel'nikov, and V. G. Tereshchenko.
Journal of Ichthyology, Vol. 23, No. 4, p 1-7, 1983. 3 Fig, 1 Tab, 20 Ref.

Descriptors: *Fish populations, *Population dynamics, Lakes, Reservoirs, Rybinsk Reservoir, Lake Balkhash, Ecosystems, Species diversity.

With the intensification of the anthropogenic effect on many aquatic ecosystems, disruption of the ecological balance is observed, leading to sharp changes in the abundance of fish species. These are usually ecosystems in the process of formation, such as reservoirs, and isolated lakes. The catch dynamics of fish in two incipient ecosystems, Rybinsk Reservoir and Lake Balkhash, are considered. The dynamics of change in the abundance of individual fish species in the formation of ecosystems is distinguished by great diversity. A fuller quantitative analysis of the change in the structure of the ichthyocoenoses of the ecosystems investigated is obtained using information indicators. These indicators make it possible to compare quantitatively the degree of diversity and disorder in catches, both in one body of water in different years and in different bodies of waters in the same years. In general, the degree of nonuniformity of the contribution of individual fish species to the total catch in both ichthyocoenoses in the years examined showed a tendency to increase. The ranges of fluctuations in indicators, the absolute and relative oganization of fish catches both for the one and the other body of water are about the same, indicating that the organization of both systems is about equal, though in individual years it is noticeably greater in Lake Balkhash than in Rybinsk Reservoir. This study shows that in these years the degree of inequality in the contribution of individual species of Lake Balkhash fish to the total catch was greater than in Rybinsk Reservoir. (Baker-IVI)
W84-04766

2I. Water In Plants

VEGETATION PATTERNS RELATED TO ENVIRONMENTAL FACTORS IN A NEGEV DESERT WATERSHED,
Cornell Univ., Ithaca, NY. Section of Ecology and Systematics.
L. Olsvig-Whittaker, M. Shachak, and A. Yair.
Vegetatio, Vol. 54, No. 3, p 153-165, November, 1983. 4 Fig, 3 Tab, 37 Ref.

Descriptors: *Vegetation, *Deserts, *Watersheds, *Negev Desert, *Israel, Plant growth, Spatial distribution, Arid regions, Soil water.

Pattern analysis was effectively used to demonstrate relationships between spatial patterns of vegetation, surface structure, and movements of soil and water in a Negev Desert watershed. Three strip transects, each about 100 contiguous 0.5 x 1 sq m quadrants, were sampled during the spring bloom of March 1981 across four surface structural units of a Negev Desert research watershed at Sede Boqer, Israel. Presence of all vascular plants was recorded. Data were subjected to detrended correspondence analysis, and resulting spatial patterns of species distribution and abundance were compared. Large-scale gradients of vegetation were related to differences in soil moisture availability among the four structural units. Where microscale vegetation patterns were important, these correlated with rock and crevice microtopography. Species richness was influenced by high numbers of therophytes on the dry upper slope of the watershed and their reduced importance on the lower three units. Relationships between vegetational patterns and known ecosystem properties of the watershed are discussed. The pattern analysis approach was developed to describe vegetation and it has been useful as a heuristic method for the detection of correlations upon which future research in this watershed project can be based. (Baker-IVI)
W84-04191

SUMMER WATER RELATIONS OF ABIES LASIOCARPA, PICEA ENGELMANNII, AND PINUS CONTORTA AT HIGHER AND LOWER ELEVATION SITES IN SOUTHEASTERN WYOMING,
Wyoming Univ., Laramie. Dept. of Botany.
G. A. Carter, J. L. Hadley, W. K. Smith, and D. H. Knight.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159714, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, Wyoming Water Research Center, Laramie, December, 1983. 24 p, 6 Fig, 3 Tab, 9 Ref. Project No. OWRT A-035-WYO (1), Contract/Grant No. 14-34-0001-2154.

Descriptors: *Soil-water-plant relationships, *Stomatal transpiration, Evapotranspiration, Water stress, Plant water potential, Forests, *Spruce, *Pine, *Fir, *Wyoming, Engelmann spruce, Subalpine fir, Lodgepole pine, *Leaf conductance.

Leaf conductances (g sub wv) to water vapor loss were determined from late May through mid-August for Picea engelmannii, Abies lasiocarpa, and Pinus contorta at 2860 m, and for Picea engelmannii and Abies lasiocarpa at 3200 m in the Medicine Bow Mountains of Wyoming. Moist soil conditions persisted throughout the summer. Near- or below-freezing air temperatures in late spring and early summer limited maximum g sub wv in spruce and fir at 3200 m to 0.4 and 0.1 mm/s, respectively. Following onset of consistently non-freezing nights, maximum daily g sub wv in all species at both elevations generally increased over the summer, but low soil temperatures at the higher elevation site appear to be a primary factor limiting maximum g sub wv. Diurnally, spruce g sub wv was generally greater than fir g sub wv, and pine g sub wv was higher than in either spruce or fir from mid-to late-summer. These results will be useful in developing a computer simulation model for water flow through the subalpine spruce-fir forests of Wyoming.
W84-04226

STUDIES OF WATER UPTAKE FROM MULTIPLE SOURCES,
Minnesota Mining and Mfg. Co., St. Paul. Central Research Labs.
L. A. Errede.
Annals of Botany, Vol. 52, No. 6, p 839-847, December, 1983. 6 Fig, 7 Ref.

Descriptors: *Water uptake, *Plant water potential, Selectivity, Potometry, Membranes, Permeability, Root growth, Hydroponics, Chemical properties.

Many potometric methods for measuring water uptake utilize complicated mechanical devices that are expensive, cumbersome and require significant plant perturbation to establish good mechanical contact with the monitoring system. Water uptake in systems consisting of a potted plant and two embedded reservoirs, which had been fitted with microporous bottoms, were monitored daily over test intervals that ranged from 1 to 3 years. When both reservoirs contained aqueous solutions of the same chemical composition, plants took water from the alternate sources without bias, but when one reservoir contained tap water and the other a strong aqueous nutrient solution, an initially fluctuating bias developed. Eventually the system restabilized at an equilibrium state in which total uptake of water (in l/day) to nutrient salt (in g/day) was about 16 to 1 independent of the concentration in the nutrient solution. This equilibrium ratio was altered sharply whenever the plant was damaged severely, or whenever the quality of the water in one of the reservoirs was impaired by addition of a toxicant. The equilibrium state was re-established within 6 months following plant damage, and within a few weeks following elimination of the toxicant. The above results demonstrate that multireservoir systems, which can be assembled easily from inexpensive components, provide a reliable means for studying water uptake by a single plant from two or more independent sources, and that these systems are very sensitive to changes that affect the physiology of the plant. (Murphy-IVI)
W84-04274

EFFECT OF WATER STRESS ON GRAIN GROWTH AND ASSIMILATE PARTITIONING IN TWO CULTIVARS OF WHEAT CONTRASTING IN THEIR YIELD STABILITY IN A DROUGHT-ENVIRONMENT,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
P. K. Aggarwal, and S. K. Sinha.
Annals of Botony, Vol. 53, No, 3, p 329-340, March, 1984. 6 fig, 3 Tab, 31 Ref.

Descriptors: *Water stress, *Grain growth, *Assimilate partitioning, *Drought, Crop yield, Drought resistance, Wheat.

Grain yield of cereals is governed by the rate and duration of grain-filling which is a post-anthesis phenomenon. Assimilation and partitioning of photosynthate in relation to grain growth are of vital importance. Grain growth pattern and grain weight in relation to its position between and within spikelets showed assimilate limitation to be a factor reducing grain yield in wheat plants grown on stored moisture in the field. Estimation of the relative contribution of pre- and post-anthesis assimilates to grain yield by a C-14 labelling technique indicated that cultivar C 306, known for its stability in yield and drought-tolerance, was characterized by substantial mobilization of pre-anthesis assimilate (P), both in irrigated (24%) and unirrigated (33%) plants. As against this, in Kalyansona, a high yielding cultivar with moderate stress tolerance, the contribution of P to grain yield was only 13 and 22% in irrigated and unirrigated plants, respectively. The mobilization of amino acids, estimated from nitrogen contents at anthesis and maturity, was decreased by water stress and was accompanied by a corresponding increased transport of carbohydrates. (Murphy-IVI)
W84-04275

EFFECT OF MOISTURE STRESS ON WATER UPTAKE AND SEED GERMINATION OF TWO VARIETIES OF WHEAT,

D.A.V. Coll., Muzaffarnagar (India). Dept. of Botany.
K. P. Singh.
Acta Botonica Indica, Vol. 11, p 43-48, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Water Stress, *Water uptake, *Germination, *Wheat, Water potential, Growth, Root growth.

The germination phase of seeds is considered critical for achieving a successful agricultural crop since indirectly, it determines the crop stand density and consequently, yields especially under arid conditions. The water uptake declined with increasing water stress. In both varieties total amount of water uptake was slightly greater at higher water potentials. There was hardly any significant difference in the initial rate of water uptake among treatments at different water potentials. At all the external water potential treatments the rate of water uptake was greater in the beginning and slowed down with time. The rate and total amount of water uptake was greater in var. HD 1981 than var. UP 319. It was observed that seed germination and seedling growth were depressed with a decreasing external water potential in both varieties. The effect of water stress on seed germination percentage and shoot and root length UP 39 proved to be more resistant to increasing water stress conditions than HD 1981. (Murphy-IVI)
W84-04282

WATER-USE EFFICIENCY IN CROP PRODUCTION,
Florida Univ., Gainesville. Dept. of Agronomy.
T. R. Sinclair, C. B. Tanner, and J. M. Bennett.
BioScience, Vol. 34, No. 1, p 36-40, January, 1984. 31 Ref.

Descriptors: *Water use efficiency, *Crop yield, Transpiration, Leaves, Biomass, Water demand.

The mechanisms that influence water use efficiency in plants are reviewed. The processes regulating leaf gas exchange are studied. Additional processes and relations are assembled to analyze water use efficiency in crop biomass and grain production, then in evapotranspirational water use efficiency expressed on the basis of total water input to the system. This analysis clarifies the important variables and the opportunities available for further improvements in water use efficiencies. Only a few variables were found to be available for manipulating water use efficiency and many of these have already been exploited to a large degree. The five options for improving water use efficiency are: biochemical alterations; alteration of the cropping environment; stomatal physiology; improved harvest index; and increased proportion of transpired water. Crop production is inextricably linked to crop transpiration. To increase crop biomass production, more water must be used in transpiration. (Baker-IVI)
W84-04284

TOWARD UNDERSTANDING SOIL WATER UPTAKE BY PLANT ROOTS,
Oregon State Univ., Corvallis. Dept. of Soil Science.
E. L. McCoy, L. Boersma, M. L. Ungs, and S. Akratanakul.
Soil Science, Vol. 137, No. 2, p 69-77, February, 1984. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Soil water, *Roots, Root surface matric potential, Plant water potential, Soil physical properties, Soil-water-plant relationships, Chino clay, Pachappa sand, Indio silt loam.

Plant water uptake is examined from a uniformly rooted soil volume by numerically solving the nonlinear diffusion equation for a soil cylinder bounded externally by an insulating surface, located at the half-distance between adjacent roots and internally by the root surface. A sinusoidally varying uptake rate is employed to simulate the diurnal evaporative demand, while the actual water flux across the inner surface is controlled by the root surface matric potential through a stomatal adjustment function. The analysis is conducted for Chino clay, Pachappa sand, and Indio silt loam, using hydraulic parameters determined from piecewise continuous exponential functions of the dependent variable matching data for these soils. The analysis uses root radii of 0.003, 0.005, 0.010, and 0.020 cm and root densities of 0.080, 0.142, 0.318, and 0.650 cm root length per cubic centimeter of soil. The transient matric potential distribution in the soil depends strongly on the precise nature of the hydraulic parameters for each soil: as the soil loses water by transpiration, the value of the bulk soil matric potential decreases monotonically at a rate dependent upon the specific water capacity of the soil. For initial bulk soil potentials of -0.3 bar in the Chino and Indio, and -0.2 bar in the Pachappa, the initial rate of potential decrease with time is greatest in the Chino, followed by the Pachappa and Indio, respectively. The corresponding radial potential distribution around individual roots depend upon the instantaneous value of the soil water diffusivity, which decreases as the soil dries, creating steep potential gradients adjacent to the root, with the largest initial gradients occurring in the Chino clay, followed by equivalent gradients in the Pachappa sand and Indio silt loam. The relative rate of decrease in the bulk soil potential and the drawdown around a root for the three soils, however, changes with time as the soil dries. The drawdown around a root is reduced by increasing root densities, so that at low densities the root surface potential depends more closely upon the diffusivity, whereas at high densities the root surface potential depends more closely upon the specific water capacity. In addition, roots of smaller radii exhibit greater drawdown as the total root surface area decreases and the flux of water at the root surface increases. The simulation of root water uptake using piecewise continuous functional relationships for the diffusivity and specific capacity produces results that form a coherent illustration of plant survival in three diverse soil environments. (Murphy-IVI)
W84-04344

OPTIMUM WATER USE BY STONE FRUIT THROUGH IRRIGATION SCHEDULING,
Michigan State Univ., East Lansing. Dept. of Horticulture.
J. A. Flore, and V. F. Bralts.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84169408, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September, 1983. 54 p, 22 Fig, 10 Tab, 11 Ref. Project No. OWRT B-060-MICH(1), Contract/Grant No. 14-34-0001-1235.

Descriptors: *Irrigation requirements, *Fruit, Crops, *Trickle irrigation, *Michigan, *Plant growth, Soil moisture, *Irrigation scheduling, Cherry trees, Peach trees, Stone fruit.

Since 1971, trickle irrigation has been installed on an estimated 50,000 acres of tree fruit in Michigan. An estimated 20-25,000 acres of trickle irrigation has been installed on stone fruit alone. Recent grower and experiment station research reports have indicated significant increases in yield and vegetative growth through the use of trickle irrigation. Soil moisture status and growth characteristics for cherry and peach trees were determined under laboratory, greenhouse and field conditions. Determinations were made such that daily and seasonal differences in plant development could be characterized. Water stress and recovery from stress was determined. Using this data base, the most promising existing and newly developed irrigation scheduling techniques were identified. At the onset of the project, a field trial comparing existing techniques was established and analyzed along with the plant stress data and compared to existing methods.
W84-04408

PHYSIOLOGICAL RESPONSE OF ST. AUGUSTINEGRASS TO IRRIGATION SCHEDULING,
Florida Univ., Gainesville. Dept. of Ornamental Horticulture.
C. H. Peacock, and A. E. Dudeck.
Agronomy Journal, Vol. 76, No. 2, p 275-279, March-April, 1984. 7 Fig, 4 Tab, 14 Ref.

Descriptors: *Irrigation requirements, *Plants, Water requirements, Irrigation programs, Turfgrass, St. Augustinegrass, Plant physiology.

Response of St. Augustinegrass to irrigation scheduling was studied during the summers of 1980 and 1981 on a loamy, siliceous, hyperthermic Grossarenic Palendult soil. An irrigation schedule of 2-, 3-, 4-, and 6-day intervals simulated conditions ranging from grass being under no water stress to severe water stress. Field plots were constructed to maintain an undisturbed soil profile that horizontally isolated adjacent plots to prevent lateral water movement. Irrigation treatments were implemented by irrigating with evapotranspiration estimates of 0.64 cm/day in 1980 and 0.38 cm/day in 1981 at either 2-, 3-, 4-, or 6-day intervals. Plots received equal volumes of water; only irrigation timing was varied. Turfgrass swards were evaluated on 12 day cycles under water stress prior to irrigation and after 24 hr of recovery following irrigation. Measured parameters included turfgrass quality, carbon exchange rates (CRE), evapotranspiration rates (ET), plant water potential component changes, and leaf diffusive resistance, and transpiration. The 6-day irrigation schedule caused a reduction in CER and ET and concurrent increase in stomatal resistance and a loss of turgor pressure prior to irrigation. Following irrigation, CER, and ET increased, turgor pressure increased, and diffusive resistance decreased during the 12 day cycle. Changes in CER under stress were accompanied by a lowering of leaf water potentials. However, the most important changes in leaf water potential values were the significant increases from preirrigation to recovery. This implies that St. Augustinegrass may be under water stress at high leaf water potentials. (Baker-IVI)
W84-04419

WATER TABLE DEPTH INTERACTION WITH NITROGEN RATES ON SUBIRRIGATED CORN,
South Carolina Agricultural Experiment Station, Clemson.
J. R. Woodruff, J. T. Ligon, and B. R. Smith.
Agronomy Journal, Vol. 76, No. 2, p 280-283, March-April, 1984. 4 Fig, 6 Tab, 13 Ref.

Descriptors: *Irrigation programs, *Nitrogen, *Corn, *Water table, Crop yield, South Carolina, Nitrogen loss, Drainage, Subirrigation, Nitrates.

Water table control for both drainage and subirrigation holds potential benefit to crop production on many soils with imperfect drainage. In this 3 year field study, four N rates were superimposed over three water table depths to test the effect of water table depth on corn response to N in a Chewacla silt loam. Water table depths were 0.35, 0.70, and 1.00 m and N rates were 0, 112, 224, and 336 kg/ha. The effects of N fertilization depended on the water table depth. For the 3 year means, quadratic regressions described the relationship between N rate and ear yield or leaf N for each water table depth except 1.00 m ear yield for which no response to N fertilizer was obtained. These findings support earlier reports that corn yields may decrease with water tables less than 0.75 m beneath the soil surface and offer as partial explanation the loss of N efficiency as the water table becomes too shallow. (Baker-IVI)
W84-04420

WATER RELATIONS AND NET PHOTOSYNTHESIS IN HYBRID GERANIUM,
Georgia Univ., Athens. Dept. of Horticulture.
A. M. Armitage, H. M. Vines, Z.-P. Tu, and C. C. Black.
Journal American Society of Horticultural Science, Vol. 108, No. 2, p 310-314, March, 1983. 8 Fig, 1 Tab, 14 Ref.

Descriptors: *Water stress, *Photosynthesis, *Plant growth, Geraniums, Water requirements, Soil water potential, Soil-water-plant relationships.

The relationships of net photosynthesis (Pn) to soil water potential, leaf diffusive resistance, leaf water potential, and relative water content were studied

th hybrid geranium grown under conditions of eenhouse pot cultures. Net photosynthesis went rough 4 stages according to the effects of water ess on the plants. As water stress increased, Pn nt from a steady-state maximum rate to slow cline, to rapid decline, to total inhibition. During id Pn decline, soil water potential rapidly deased from -4 bars to -14 bars, and leaf diffusive istance increased from 4 s/cm to 80 s/cm. Leaf ter potential was -7 bars, and relative leaf water ntent was 81-87%. Leaf water potential apared to be the best indicator of imminent Pn cline. After rewatering waterstressed plants, 3 ys were required to elevate Pn to a steady-state ximum which was only 90% of the initial ady-state Pn. This work is of immediate interest the production of geraniums. Although water essed geranium plants do not visually show the ssical symptoms of wilt due to their waxy cuti-, their rate of Pn rapidly declines. During gera-m production attention must be paid to the tering regime, or a reduction of Pn will occur m which leaves will not fully recover. (Baker-I)
84-04421

ELD QUANTIFICATION OF CROP WATER RESS,
gricultural Research Service, Phoenix, AZ. ater Conservation Lab.
J. Reginato.
ansactions of the American Society of Agricul-al Engineers, Vol. 26, No. 3, p 772-775 and 781, ay-June, 1983. 6 Fig, 14 Ref.

escriptors: *Remote sensing, *Water stress, lant water potential, *Stomatal conductance, otton, Irrigation requirements, Vapor pressure, op water stress index, Plant temperature.

emotely sensed plant temperature was used as a imary factor for evaluating crop stress by by use a crop water stress index (CWSI). The CWSI is lated to two physiological parameters commonly ed to quantify plant stress: leaf water potential d stomatal conductance. Leaf water potential is inversely related to the air vapor pressure ficit under well-watered conditions in cotton. btracting this atmospheric-induced leaf water tential from the total potential, resulted in a soil-duced leaf potential, which appears to be inverse-linearly related to the crop water stress index. af stomatal conductance was also inversely re-ed to the CWSI. As the index increased from ro to 0.20, the conductance decreased from its aximum value of 2.6 cm/s to about 12 cm/s. The lue of the CWSI is shown in terms of scheduling igations and predicting lint cotton yield. loore-IVI)
84-04440

ROLINE ACCUMULATION AND RELATIVE ATER CONTENT IN SOYA BEAN (GLYCINE AX) VARIETIES UNDER WATER STRESS,
waharlal Nehru Krishi Vishwa Vidyalaya, Jabal-r (India). Dept. of Plant Breeding and Genetics.
B. Singh, and D. P. Gupta.
nnals of Botany, Vol. 52, No. 1, p 109-110, July, 83. 1 Tab, 14 Ref.

escriptors: *Water stress, *Proline, *Soybeans, rop yields, Drought resistance.

Vater stress causes several-fold accumulation of ee proline in leaves of many plant species, and it as been suggested that this phenomenon can be ed to screen crop cultivars for drought resist-nce. The effects of water stress on proline accu-ulation and relative water content of four soya ean varieties were studied. Two local strains, alitur and T-49 showed a smaller increase in roline content and greater reduction in relative ater content than did JS-2 or Bragg under the me conditions of stress. These findings suggest at the accumulation of free proline by plants bjected to water stress may be used as an index r screening soya bean cultivars for drought toler-nce. (Baker-IVI)
84-04526

ABSCISIC ACID AND WATER RELATIONS OF RICE (ORYZA SATIVA L.): EFFECTS OF DROUGHT CONDITIONING ON ABSCISIC ACID ACCUMULATION IN THE LEAF AND STOMATAL RESPONSE,
Agricultural Research Council, Trumpington (England).Plant Breeding Inst.
I. E. Henson.
Annals of Botany, Vol. 52, No. 2, p 247-255, August, 1983. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Abscisic acid, *Rice, *Drought conditioning, *Accumulation, *Stomatal transpiration, Water stress, Turgidity, Stomata.

The effects of a period of water stress (drought conditioning) on responses to a second (challenge) stress were examined in young vegetative rice (Oryza sativa L.) plants. Drought conditioning did not affect the rate of subsequent stress development, nor, in a first experiment, did it influence relations between turgor (psip) and total (psi) leaf water potential. However, conditioning did extend the range of psip over which stomata remained open and significantly reduced the amount of ABA which accumulated in the leaf at a given psip. The change in stomatal behavior (stomatal adjustment) was quantitatively accounted for by the change in leaf ABA accumulation. The reduction in ABA accumulation due to conditioning did not involve a change in the potential capacity to produce ABA, as ABA accumulation in partially dehydrated detached leaves was not reduced by conditioning. It is suggested that effects of conditioning on leaf ABA content in the intact plant involve changes in the rate of ABA export from the leaf. (Author's abstract)
W84-04527

ABSCISIC ACID ACCUMULATION IN DETACHED LEAVES OF RICE (ORYZA SATIVA L.) IN RESPONSE TO WATER STRESS: A CORRELATION WITH LEAF SIZE,
Agricultural Research Council, Trumpington (England).Plant Breeding Inst.
I. E. Henson.
Annals of Botany, Vol. 52, No. 3, p 385-398, September, 1983. 9 Fig, 3 Tab, 27 Ref.

Descriptors: *Abscisic acid, *Accumulation, *Water stress, *Leaf size, *Correlation analysis, *Rice, Leaves, Water potential.

When water stress was imposed on detached leaves of two rice (Oryza sativa L.) cultivars, more ABA per unit fresh weight accumulated in IR20, a small-leaved cultivar, than in 63-83, a large-leaved cultivar; the difference being up to threefold. In an F2 population of a cross between the two cultivars ABA accumulation was found to be significantly negatively correlated with leaf fresh weight. This correlation persisted in the F3 generation. Such a correlation was not evident, however, when a number of rice cultivars, which varied widely in leaf size, were examined. The difference in ABA accumulation between IR20 and 63-83 was not accounted for by different spatial patterns of water loss or ABA accumulation within a leaf, and cultivar differences in ABA content were maintained both across, and at various positions along the leaf. No major differences in leaf anatomy were observed between the two cultivars. Differences found in leaf water relations characteristics were few and generally minor. It therefore seems unlikely that these properties account for the difference between the cultivars in the ability to accumulate ABA or for the correlation with leaf size. (Author's abstract)
W84-04528

A MODEL OF COMPETITION BETWEEN TREES AND GRASS FOR RADIATION, WATER AND NUTRIENTS,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Div. of Forest Research.
R. McMurtrie, and L. Wolf.
Annals of Botany, Vol. 52, No. 4, p 449-458, October, 1983. 3 Fig, 34 Ref.

Descriptors: *Model studies, *Trees, *Grass, *Radiation, *Water requirements, *Nutrients, Nutrient requirements, Mathematical models, Plant competition, Competing use, Carbon, Photosynthesis.

Plants often compete by depleting resources required by neighbors. The resources for which this competition is most important are radiation, water and nitrates. Conditions for the coexistence of trees and grass are explored using a mathematical model describing plant competition for radiation, water and nutrients. The model describes growth of both species in terms of key physiological processes (radiation interception, photosynthesis, respiration, grazing, litterfall, assimilate partitioning, nutrient uptake and water use) and is used to analyze how species compete by depriving each other of resources essential for growth. Changes of growth parameters are shown to lead to shifts in species composition (e.g. through replacement of one species by another). (Murphy-IVI)
W84-04529

COMPARISON OF THE EFFECTS OF WATER STRESS ON THE ROOT SYSTEMS OF TWO CULTIVARS OF UPLAND RICE (ORYZA SATIVA L.),
CEA Centre d'Etudes Nucleaires de Cadarache, Saint-Paul-les-Durance (France).
J. F. Bois, and P. H. Couchat.
Annals of Botany, Vol. 52, No. 4, p 480-487, October, 1983. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Comparison studies, *Water stress, *Roots, *Rice, Neutron radiography, Drought resistance, Root development.

In West Africa and especially in the Ivory Coast, rainfall is very irregular and the soil used for cultivation of upland rice usually has a low water table. Harvesting is affected when a drought period, even of short duration, occurs at a crucial time in the life cycle. Neutron radiography was used to study root development in upland rice (Oryza sativa L.) during and after a short period of drought. The limit of resolution (approx. 0.1 mm) of the method allows for the study of the adventitious root system in rice during the tillering stage. However the resolution is not sufficient to study development of the seminal system. Enlargement of neutron radiographs shows further details of primary root system. Thirty-six-day-old seedlings of two rice cultivars were subjected to a 4-day water stress followed by rewatering. Neutron radiography dehydration and inhibition of root growth during water stress. During post-drought rewatering, the two cultivars behaved differently with regards to the secondary root growth recovery. (Murphy-IVI)
W84-04530

NITROGEN UPTAKE BY WHEAT IN RELATION TO WATER REGIME AND DEPTH OF N PLACEMENT IN A LOAMY SAND SOIL: MEASUREMENT AND MODEL SIMULATION,
Indian Agricultural Research Inst., New Delhi.
B. R. Sharma, and T. N. Chaudhary.
Journal of Soil Science, Vol. 35, No. 1, p 141-148, March, 1984. 5 Tab, 17 Ref.

Descriptors: *Nitrogen, *Simulation, *Model studies, *Loamy sand, *Wheat, *Soil-water-plant relationships, Fertilization, Soil organic matter, Mathematical equations.

Nitrate-N distribution in soil, root-length, rate of water uptake and flux of nitrate-N to wheat roots as influenced by moisture regime and depth of nitrogen placement were studied in 60 cm diameter by 180 cm deep metal columns filled with loamy sand soil. The contribution of the different soil depths in the root zone towards total N uptake was calculated employing a convective-diffusion model and compared with the experimentally measured N uptake by wheat plants. Under non-irrigated conditions with surface-mixing of N(Ns) concentrations of nitrate, root-lengths and water uptake rates were high only in the upper soil layers. With deep placement of N(Nd), the lower layers also contributed significantly towards total N uptake and total N uptake was greater with Nd than with Ns. The deep placement of fertilizer N in coarse textured

soil results in its more uniform distribution in the root zone, more extensive root proliferation and enhanced sub-soil water utilization. It should ensure a greater nitrogen uptake by roots as they would encounter a nitrogen rich zone. It is likely to be of great importance when post-seeding surface irrigation or rainfall is not available. In spite of many simplifying assumptions and certain estimates the predicted values of N uptake were quite close to those measured experimentally. (Murphy-IVI)
W84-04578

WATER UPTAKE BY ROOTS CONTROLS WATER TABLE MOVEMENT AND SEDIMENT OXIDATION IN SHORT SPARTINA MARSH,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W84-04767

DIURNAL VARIATIONS IN LEAF WATER POTENTIAL AND STOMATAL CONDUCTANCE OF PIGEON PEA (CAJANUS CAJAN (L.) MILLSP.) CULTIVARS AS AFFECTED BY IRRIGATION LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
K. P. Singh, R. S. Malik, and D. S. Malik.
Biologia Plantarum (Praha), Vol. 25, No. 1, p 1-4, 1983. 2 Fig, 6 Ref.

Descriptors: *Water potentials, *Stomatal conductance, Pigeon pea, Diurnal variations, Irrigation effects, Crop yield, Drought tolerance.

Pigeon pea (Cajanus cajan) is grown in northwest India during the rainy season. The crop suffers due to water stress when the monsoon rains are over. This period coincides with the reproductive stage of the crop, and water stress at this stage results in the maximum loss in production. Two cultivars of pigeon pea, UPAS-120 and Parbhat, were grown in the field under two irrigation treatments: no irrigation and irrigation when cumulative pan evaporation was equal to 50% depletion of available water content in one meter root zone depth. Diurnal changes in leaf water potential and stomatal conductance were recorded on two days i.e. October 1, 1979 and October 28, 1979 which corresponded to reproductive growth stage of the crop. Plant water potential decreased rapidly during the day up to about 1500 hr and increased during evening hours. Higher leaf water potential was recorded in irrigated treatment on both dates. Adaxial stomatal conductance started declining during early morning hours, however, abaxial conductance increased up to 0900 hr then decreased and increased again in the afternoon except in irrigated crop of cv. UPAS-120 on 28th October, where conductance never increased after 0900 hr. The reduced rate of stomatal conductance during day hours may be identified as one of the characteristics responsible for drought tolerance in pigeon pea. (Moore-IVI)
W84-04771

WATER RELATIONS PATTERN OF UNDERSTOREY SPECIES INFLUENCED BY SUNFLECKS,
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
P. Ellias.
Biologia Plantarum (Praha), Vol. 25, No. 1, p 68-74, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Solar radiation, *Understory, *Transpiration rate, *Stomatal conductance, Forests, Irradiance, Canopy.

Irradiance (I) in a plant community is characterized by very large temporal and spatial variability. The uneven distribution of I in the understory of a forest stand is due to penetration of direct beam radiation through canopy openings (occurrence of sunflecks). Water relations of plant cenopopulations of understorey species (7 herbaceous perennials, 1 shrub, and 1 tree seedling) growing in an oak-hornbeam forest in SW Slovakia (Czechoslovakia) is markedly influenced by natural sunflecks moving on the forest floor, where stomatal conductance and transpiration rate are significantly higher than in shade areas. In the course of a day, the leaf stomatal conductance fluctuates, following irradiance of the leaf, from minimum in full shade to maximum in sunflecks, including intermediate values in transient conditions. Therefore, there is also a large variability in water saturation deficit and transpiration rate within the cenopopulations of the understorey species. These variations should be considered in modelling the physiology of woodland understorey species. (Moore-IVI)
W84-04772

EFFECT OF CALCIUM ON WATER-STRESS-INDUCED BIOCHEMICAL CHANGES AND YIELD OF FIELD-GROWN RICE,
Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
For primary bibliographic entry see Field 3F.
W84-04773

EFFECTS OF WIND VELOCITY ON STOMATAL CONDUCTANCE AND CONSEQUENCES OF LEAF ROLLING ON WATER UPTAKE IN TALL FESCUE,
Universite Catholique de Louvain, Louvain-la-Neuve (Belgium).
C. Renard, and W. Demessemacker.
Biologia Plantarum (Praha), Vol. 25, No. 6, p 408-411, 1983. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Transpiration, *Water loss, *Leaf rolling, *Stomatal conductance, *Fescue, Leaves, Plants, Wind velocity, Stomatal transpiration, Water conservation, Grasses.

Leaf form and stomatal characteristics play an important part in the strategy of tall fescue to limit water losses. The effect of leaf rolling on transpiration of tall fescue leaves is considered. Fully expanded leaves of tall fescue were used for the measurements. Total diffusive conductance, obtained by adding conductance of adaxial and abaxial faces, is significantly affected at values of wind speed of 3 m/s. Effect of leaf rolling was studied only at degrees 1, 3, and 5 owing to the difficulty of simulating other degrees. When leaf is rolled at degrees 3 and 5, water uptake ratio was decreased by 65% at values of wind speed of 21 m/sec. At high wind velocities, water uptake is increased a 2 m/sec and decreased at 3 m/sec when the leaf is unrolled. Results thus confirm that leaf rolling is effective in decreasing water uptake by individual leaves and that leaf transpiration rate is affected. (Baker-IVI)
W84-04774

RELATIONSHIP BETWEEN SOIL MOISTURE AND LEAF WATER POTENTIAL OF THREE FOREST TREE SPECIES,
Slovenska Akademie Vied, Bratislava (Czechoslovakia). Ustav Hydrologie a Hydrauliky.
J. Huzulak, and F. Matejka.
Biologia Plantarum (Praha), Vol. 25, No. 6, p 462-467, 1983. 1 Fig, 9 Ref.

Descriptors: *Plant water potential, *Soil water, Trees, Mathematical models, Oak, Maple, Hornbeam, Vapor pressure deficit, Wilting, Drought resistance.

A mathematic model of leaf water potential daily dynamics was employed to study the relationship between this characteristic and soil moisture for the species Quercus cerris, Acer campestre and Carpinus betulus. It was found that when evaluating the availability of soil water for a plant it is necessary to consider the vapor pressure deficit which remarkably affects the relationship between the soil moisture and leaf water potential. A quantitative description of the dependence between the leaf water potential and soil moisture enabled a physiological interpretation of the limit values of soil moisture - permanent wilting and reduced availability of soil water for the plant - as well as evaluation of drought resistance of plants. (Author's abstract)
W84-04775

DIURNAL VARIATION IN LEAF WATER POTENTIAL, STOMATAL CONDUCTANCE, AND IRRADIANCE OF WINTER CROP UNDER DIFFERENT MOISTURE LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
For primary bibliographic entry see Field 3F.
W84-04776

AN IMPROVED SYSTEM OF SUBJECTING PLANTS TO WATER STRESS,
Allahabad Univ. (India). Plant Physiology Lab.
P. N. Singh, R. Prasad, M. Salim, and A. Sharga.
Biologia Plantarum (Praha), Vol. 26, No. 1, p 16-21, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Water stress, *Plant growth, *Translocation, Plant physiology, Barley, Nitrogen, Phosphorus, Polyethylene glycol.

An improved system of plant cultivation at stable and specific levels of polyethyleneglycol (PEG, mol. mass 1400-1600) - induced water stress has been described. To set up this system a perforated tubular glass vessel containing soil to support seedling growth was wrapped externally first with a layer of macroporous silica gel-G and then with three layers of a dialysis membrane of a lower exclusion limit (200 mol. mass). Effects of 8 days of PEG - induced stress have been studied on uptake and translocation of N and P and growth of barley (Hordeum vulgare L. cv. KN 16) seedlings. Some of the noteworthy improvements of the system were exclusion of PEG from the plant consequent upon use of silica gel-membrane combination, shorter time (2 days) for the soil-plant-air continuum to attain steady state and stability of the plant water potential over a period of a few days. (Author's abstract)
W84-04777

2J. Erosion and Sedimentation

DIVERSION WORKS AND SEDIMENT TRANSPORT (OUVRAGES DE DERIVATION ET TRANSPORTS SOLIDES),
For primary bibliographic entry see Field 8B.
W84-04221

SOLUTE RELEASE AND SEDIMENT ENTRAINMENT ON MICROCATCHMENTS IN THE DINOSAUR PARK BADLANDS, ALBERTA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
R. B. Bryan, A. C. Imeson, and I. A. Campbell.
Journal of Hydrology, Vol. 71, No. 1-2, p 79-106, March 15, 1984. 9 Fig, 8 Tab, 27 Ref.

Descriptors: *Sedimentation, *Entrainment, *Microcatchments, *Solute transport, *Dinosaur Park Badlands, *Alberta, *Canada, Storm runoff, Sodium montmorillonite, Hydrographs.

The uptake of solutes and entrainment of sediments in runoff generated by simulated rainstorms on different badland surfaces, and the properties of the regolith materials related to solute uptake are described and studied in a number of simple laboratory experiments. Field and laboratory results are in close agreement. Runoff, solute and sediment uptake are profoundly influenced by the large amounts of sodium montmorillonite present in the regolith. Shale surfaces, although responding late to rainfall, release increasing amounts of sediment and solutes (sodium and sulfate) as they swell and increase in erodibility. On other surfaces low rates of rainfall acceptance are caused by the secretion of montmorillonite gels, and there is a gradual decrease in solute and sediment concentration as accumulated salts are flushed from the surface. The effect of the chemistry of the simulated rainfall on the experiment results is examined. It is considered possible to characterize the pattern of solute and sediment uptake on the different badland surfaces and to apply this information to the identification of runoff sources in mesoscale drainage basins and to the routing of storm runoff. (Murphy-IVI)
W84-04302

PRELIMINARY ESTIMATES OF LOADS CARRIED BY RIVERS TO ESTUARIES AND COASTAL WATERS AROUND GREAT BRITAIN DERIVED FROM THE HARMONIZED MONITORING SCHEME,
For primary bibliographic entry see Field 5B.
W84-04316

SEDIMENTATION PROCESSES IN THE BRISTOL CHANNEL/SEVERN ESTUARY,
Institute of Oceanographic Sciences, Taunton (England).
For primary bibliographic entry see Field 2L.
W84-04334

PHYSICAL AND CHEMICAL PROPERTIES OF ERODED SOIL AGGREGATES,
Agricultural Research Service, Columbia, MO. North Central Watershed Research Center.
E. E. Alberts, R. C. Wendt, and R. F. Piest.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 465-471, March-April, 1983. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Soil aggregates, *Iowa, *Soil erosion, Rill erosion, Interrill erosion, Clay, Nitrogen, Phosphorus, Sediment transport, Loess soils, Simulated rainfall.

Rainfall simulation was used to evaluate the characteristics of aggregates eroded from erosion plots on two loess soils in southwestern Iowa. The mean aggregate diameters (D50) for interrill erosion were 44 and 34 micro m for soils with 26% clay and 1.9% carbon and 22% clay and 0.8% carbon in their matrix, respectively. The D50 size increased as rilling occurred, but the percentage of increase was quite different for the soils. The D50 size increased by 91% for the soil with higher clay, whereas it increased by only 15% for the other soil. The eroded aggregates >50 micro m in diameter contained more clay and total nitrogen than did the aggregates <50 micro m, when analyzed as a single fraction. The >50-micro m aggregates were also enriched in clay and nitrogen when their contents were compared to those of the matrix soil. Enrichment was greater for interrill than for interrill plus rill erosion because of greater particle selectively during the transport process. Equilibrium phosphorus concentration curves varied with aggregate size, suggesting that 250 to 50-micro m aggregates are of greater importance in buffering soluble P levels and transporting labile P than larger aggregates. (Author's abstract)
W84-04430

EVALUATION AND COMPARISON OF TWO METHODS FOR CHARACTERIZATION OF SEDIMENT SIZE DISTRIBUTION,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
W. H. Neibling, W. C. Moldenhauer, and B. M. Holmes.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 472-480, March-April, 1983. 13 Fig, 4 Tab, 11 Ref.

Descriptors: *Sediments, *Soil erosion, *Particle size, Soil aggregates, Storage time, Sample preparation, Decantation, Pipetting.

The effect of storage time on aggregate size analysis and two methods of analysis (pipette and decantation) to separate naturally eroded sediment into 11 size fractions ranging from <2 micro m to 35 micro m are described. Five sets of 49 samples each from Indiana soils were used to test if storage times of 0, 1, 2, 3, 7, 30 or 180 days before particle size separation was performed caused significant differences in the measured particle size distribution for either of the two methods. For samples between 35 and 500 micro m (separated by wet sieving in the laboratory) effects of storage time on the particle size distribution were significant after 30 days. For the size fractions smaller than 35 micro m separated by pipette storage time was significant after 30 days. Storage time was significant after 180 days only in 3 of 20 storage time-size fraction combinations for the decantation method. Differences in the percent of sediment found in each size class between the two methods were highly significant for each size fraction <35 micro m for all five soils. Differences of 20 mm in the effective depth range actually sampled by the pipette and differences from 8 to 18 s between times required to fill the 10 mL pipette did not significantly affect particle size. Increasing pipette withdrawal depth from 50 to either 100 or 150 mm essentially doubled the dry weight of soil obtained in a pipette for the 20 to 35 micro m fraction. Results using the same withdrawal depths for <2, 2 to 10, and 10 to 20 micron fractions showed only minor differences between depths. (Author's abstract)
W84-04431

POSSIBLE ERRORS DURING FIELD EVALUATIONS OF SEDIMENT SIZE DISTRIBUTIONS,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
L. D. Meyer, and S. H. Scott.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 481-486, March-April, 1983. 5 Tab, 13 Ref.

Descriptors: *Sediments, *Sediment erosion, *Particle size, *Sample preparation, Runoff, Field tests.

The size distribution of sediment eroded during rainstorms is an important factor affecting the transportability of such sediment. Since sediment samples from some soils may either break down further or reaggregate during storage, it is preferable to make sediment-size evaluations immediately after collection. Field analyses of size distributions of sediment from aggregated soils necessarily involve conditions that may adversely affect the resulting data. Most of these conditions can cause inaccurate sieving and pipetting, so wet sieving and pipette withdrawal techniques are described that help minimize errors. Experiments were conducted to evaluate the effects of air and water temperature variations, different sediment sample size, variable pipette withdrawal depths, and vibrations from pumps and motors. For the range of such conditions encountered during field research, only insufficient sediment in the runoff samples that caused very low sediment concentrations for the pipette analysis showed evidence of seriously affecting the resulting sediment size distributions. Sediment size distributions can be made accurately in the field if suitable equipment and good quality water are used, proper procedures are followed carefully, and certain potential problems are avoided. (Moore-IVI)
W84-04432

MEASUREMENT OF FINE SILT AND CLAY SIZE DISTRIBUTIONS,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
F. R. Schiebe, N. H. Welch, and L. R. Cooper.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 491-496, March-April, 1983. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Sediments, *Particle size, *Clay, *Silt, Lake sediments, Mathematical methods.

Three different commercial particle-size analyzers were compared with the conventional pipet technique to measure the size distributions of samples of very fine sediments. The Electrozone system operates on the principal of electrical conductivity change caused by particles moving through a small orifice. The Sedigraph is based on the gravitational settling in Stokes range and mass determination by x-ray attenuation. The Model 7991 Microtrac uses detection of the intensity and scattering angle of laser light by particles. The 15 samples were obtained from the deposited sediments in several oxbow lakes in the alluvial plain in west central Mississippi. Approximately 90% of the material in these samples were less than 10 micro m in size. The basic features, principles and underlying assumptions for each instrument are outlined and compared for all analyzers and techniques used. While the results from the four methods showed drastic differences, reconciliation of this data was achieved by use of simple mathematical descriptions of the particle size distributions and of the measurement processes involved with each instrument. (Moore-IVI)
W84-04433

RAINFALL CHARACTERISTICS AND THEIR RELATION TO SPLASH EROSION,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W84-04443

DEPOSITION OF NONUNIFORM SEDIMENT ON CONCAVE SLOPES,
Soil Conservation Service, West Warwick, RI.
S. S. Davis, G. R. Foster, and L. F. Huggins.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1057-1063, July-August, 1983. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Overland flow, *Sediment deposition, *Slopes, Aggregates, Coal, Sand, Specific gravity, Sediment yield, Sediment transport.

A laboratory study was conducted to investigate behavior of simulated natural sediments transported and deposited by overland flow on concave slopes. Natural sediment is a heterogeneous mixture of primary particles and aggregates having nonuniform distributions of diameter and density. Coal as aggregate substitutes and sand were studied both as separate homogeneous sediments and combined as hetergeneous sediment mixtures. Specific gravity was more important than diameter in the transport and deposition of different particles types in a mixture. The particles with the lower specific gravity traveled much further downslope before being deposited than did the particles with the higher specific gravity. Before considerable sediment was deposited on the slope, most of the sediment yield was particles having the smaller specific gravity. As deposited sediment accumulated, the portion of sediment yield consisting of sediment with the larger specific gravity increased. (Author's abstract)
W84-04448

EROSION OF SOIL AND POULTRY MANURE - A LABORATORY STUDY,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W84-04450

SOIL ERODIBILITY VARIATION DURING THE YEAR,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, and C. E. Carter.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1102-1104 and 1108, July-August, 1983. 9 Fig, 3 Tab, 13 Ref.

Descriptors: *Soil erosion, *Soil loss, *Air temperature, Erodibility, Soil water, Holly, Mississippi, Morris, Minnesota.

Current usage of the K factor in the Universal Soil Loss Equation assumes that soil has an inherent erodibility that is constant throughout the year. The variable erodibility of soil due to variations in soil moisture, especially, does not allow accurate soil loss estimates for periods shorter than a year unless this variability is accounted for directly or indirectly by some other soil erosion factor. Six years of data from erosion plots at Holly Springs, MS, and 10 yr of data from plots at Morris MN, were used to study variation in soil erodibility through the year. Monthly values of soil erodibility were related to time with a cosine curve. Erodibility varied from a high of 169% of annual average K (K of the Universal Soil Loss Equation) on February 4 to a low of 31% of annual average on August 5 for the Mississippi data. Minnesota erodibility data were described similarly except the maximum and minimum of the erodibility function lagged the Mississippi curve by about 2 months. For predicting erodibility, normal monthly air tem-

peratures were found to be well represented by a cosine function different from the erodibility function only in amplitude and initial time. (Moore-IVI)
W84-04453

CHANNEL MORPHOLOGY CHANGES AND SEDIMENT YIELD FOR A SMALL AGRICULTURAL WATERSHED IN IOWA,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. M. Hamlett, J. L. Baker, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1390-1396, September-October, 1983. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Agricultural watersheds, *Sediment yield, *Channel morphology, *Iowa, Land use, Row-crops, Snowmelt, Runoff, Soil erosion, Sediment transport, Sediment deposition.

Channel widths, depths, and cross-sectional areas were measured at several locations on a stream draining a 50.5-sq km agricultural watershed in east-central Iowa several times during the 1964 to 1980 period. Land use became more row-crop intensive during this period, with the channel progressively increasing in width and depth. The average annual increase in channel area from 1964 to 1980 was 2.7% (0.29 sq m/yr), with the larger increases in channel dimensions associated with the 1977 to 1980 period. Runoff and sediment loads from the watershed, and field subwatersheds, were investigated for 1976 to 1980. At the field subwatersheds, snowmelt runoff was a sizeable portion of total annual runoff, yet erosion and sediment transport with snowmelt was minimal. For the stream, snowmelt sediment load (as a percentage of the total annual load) was larger than at the field sites, suggesting the possible reentrainment by snowmelt of previously deposited sediment. However, cross-sectional data for 1964 to 1967 did not substantiate the hypothesis of sediment deposition in the stream channel during the summer, with subsequent flushing of deposited sediment during snowmelt. Average sediment load attributable to channel contributions was estimated to be at least 25%. (Author's abstract)
W84-04463

CHARACTERISTICS OF RAINDROP THROUGHFALL UNDER CORN CANOPY,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
N. W. Quinn, and J. M. Laflen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1445-1450, September-October, 1983. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Drop size, *Drop velocity, *Throughfall, *Canopy, Soil erosion, Kinetic energy, Stemflow, Corn, Simulated rainfall, Erosivity.

A better understanding of the drop size and drop velocity characteristics of rainfall passing through crop canopy (throughfall) is needed to estimate throughfall erosivity (kinetic energy) and to test the assumptions upon which the canopy subfactor model of the Universal Soil Loss Equation (USLE) is based. A laboratory rainfall simulator was used to study the raindrop size and velocity under a corn canopy. The kinetic energy of throughfall relative to the kinetic energy of the simulated rainfall without a crop was compared for various row spacings, crop stages, and positions within the row. Drop sizes were measured by using a dye-paper technique, and drop velocities were measured photographically. Stemflow was calculated on the basis of rainfall under the canopy and incident rainfall above the canopy. Up to 49% of incident rainfall appeared as stemflow. Drops that directly penetrated the crop canopy accounted for much of the throughfall kinetic energy; drips from leaf margins also contributed greatly to throughfall kinetic energy. Drops that splashed from leaves were quite small and contained little kinetic energy. There was little difference between throughfall kinetic energy predicted by the USLE canopy subfactor model and those measured in this experiment even though a considerable range in canopy heights and canopy covers was experienced. The importance of drops falling from leaf margins as elements of throughfall erosivity might increase outdoors where raindrops are smaller than the drop from the simulated rainfall used for this experiment. (Moore-IVI)
W84-04471

RESPONSE OF AGGREGATED SEDIMENT TO RUNOFF STRESSES,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
F. E. Rhoton, L. D. Meyer, and F. D. Whisler.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1476-1478, September-October, 1983. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Rainfall impact, *Rill erosion, *Sediment erosion, Aggregates, Sediment size, Rainstorms, Agricultural runoff.

Aggregated sediment was subjected to stimulated runoff stresses to determine if sediment sizes eroded by raindrop impact decreased during the runoff process. The sediment was stressed in a square, continuous channel which could be rotated to simulate rill flows of 0.14, 0.28, and 0.56 m/s. Sediment sizes measured after stressing the sediment for 5 min at each flow rate were not appreciably different from reference (no-flow) sediment sizes, with the exception of one soil. The only decrease in sediment sizes occurred when the flow time at the 0.56 m/s rate was increased to 60 min. Apparently, aggregated sediment eroded by intense rainstorms undergoes little if any additional breakdown during transport by runoff through flow systems common in agricultural fields. (Author's abstract)
W84-04475

SLOPE STEEPNESS AND INCORPORATED RESIDUE EFFECTS ON RILL EROSION,
Agricultural Research Service, Columbia, MO.
M. W. Van Liew, and K. E. Saxton.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1738-1743, November-December, 1983. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Rill erosion, *Slope, *Crop residues, Straw, Soil erosion, Tillage, Runoff rate, Shear stress, Agricultural runoff.

In many locations, rill erosion is the most significant form of soil loss, but research has not separated the quantity of rill and interrill erosion when defining the effects of factors such as topography and soils. A controlled field experiment was conducted to determine the effect of runoff rate, slope steepness and incorporated residue on rill erosion. The effect of raindrop impact was minimized. Duplicate rills were tested on slopes of 9, 18, and 23%, each with incorporated wheat straw residue of about 0, 4700, and 9400 kg/ha, and two flow rates. Rill erosion by runoff without accompanying rainfall was related to slope steepness. Rill erosion varied directly with flow shear stress, but rill geometry depended on other processes, such as rill head cutting and slumping of undercut sideslopes. Rill detachment rates were reduced nearly 60% by the medium residue treatment and about 85% by the high residue treatment when compared with the no-residue treatment. The incorporated residue affected rill erosion by reducing the flow shear stress, acting as a binding agent to increase the resistance of the soil to erosion, and providing miniature grade control structures to provide depositional sites for detached soil. Tillage practices which incorporate residue into the tilled soil layer may substantially reduce soil losses from rill erosion. The results are applicable to the Universal Soil Loss Equation C-factor related to rill erosion in areas where rainfall does not significantly effect rill erosion. (Moore-IVI)
W84-04482

DISTRIBUTED PARAMETER MODELING OF SEDIMENT MOVEMENT AND PARTICLE SIZE DISTRIBUTIONS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, III, and D. B. Beasley.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1766-1772 and 1777, November-December, 1983. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Particle size, *Sediment transport, *Sediment erosion, *Mathematical models, Construction sites, Watersheds, Erosion control, Overland flow, Interception, Infiltration, Subsurface drainage.

A spatially descriptive erosion submodel for estimating the particle size distribution of eroded sediment from disturbed upland watersheds and construction sites has been developed and incorporated into the ANSWERS watershed model. Model validation is accomplished using data from field plot studies. The model's usefulness as an erosion control planning tool is demonstrated on a construction site in central Indiana. The model divides the watershed into a uniform grid of square planar elements. Within each element, the model describes the processes of interception, infiltration, surface storage, surface flow, subsurface drainage, and sediment detachment, transport and deposition. The continuity equation is then used to integrate the individual elemental responses into a system response that describes the watershed as a whole. The erosion process is limited to the overland flow regime. (Author's abstract)
W84-04484

CHANGES IN HUMUS IN LEACHED CHERNOZEMS CAUSED BY EROSION,
A. A. Tanasiyenko.
Soviet Soil Science, Vol. 15, No. 2, p 78-87, 1983. 6 Tab, 15 Ref. Translated from Pochvovedeniye, No. 4, p 116-125, 1983.

Descriptors: *Humus, *Soil erosion, *Chernozems, Agricultural runoff, Kuznetzk Basin, Soil loss, Storm runoff, Leaching, Plowing, Slope.

Changes in the composition of humus in the plowed and subsoil horizons of leached Chernozems subjected to water erosion in the Kuznetzk basin are considered. Leached Chernozems of the Kuznetsk basin have a high humus content. In the upper horizons of the soil profile it amounts to 8-13% and decreases rather abruptly downward in the profile. Moldboard plowing of slopes results in washing away every year the most fertile and humified particles and penetrating into the less humified layer. The long term effects of erosion and penetration into the soil layer depleted of humus contribute to a steady decrease in the humus content and reserves in the plowed layer and throughout the profile. Leached clayey loam Chernozems in the Kuznetsk basin lost, depending on the severity of erosion of the soil profile, 33 to 75% of the total humus reserves during the last 100 years, while the annual loss was 1000 kg from each hectare of soils on slopes. Humus in runoff products has the same features as soil humus. Most of the humus in the runoff products consists of humic acids. The carbon ratio of the humic acids to the fulvic acids varies from 1.3 to 2.0, depending on the soil moisture content and on the diameter of the particles involved. The amount of humus in the runoff products depended on the flow rate of the meltwater and rain water, whereas the composition of the organic matter in these products depended on the initial soil moisture. The composition of humic acids removed with the products of solid runoff is dominated by a mobile fraction bound to mobile sesquioxides. A characteristic of the organic matter in solid runoff products in wet soils is the unusually high content of mobile humic acids compared with plowed and especially the subsoil of noneroded and eroded Chernozems. (Baker-IVI)
W84-04522

SEDIMENT YIELD AND STORM FLOW RESPONSE TO CLEAR-CUT HARVEST AND SITE PREPARATION IN THE OUACHITA MOUNTAINS,
Weyerhaeuser Co., Hot Springs, AR. Southern Forestry Research Center.
E. L. Miller.

Water Resources Research, Vol. 20, No. 4, p 471-475, April, 1984. 3 Fig, 5 Tab, 8 Ref.

Descriptors: *Sediment yield, *Storm flow, *Clear-cutting, *Harvest preparation, *Site preparation, *Ouachita Mountains, Sedimentation, Storm runoff, Rainfall-runoff relationships, McCurtain County, Oklahoma.

Silvicultural activities used in even-aged forest management are relatively new in the Ouachita Mountains of Oklahoma and Arkansas. These practices include clear-cutting, mechanical site preparation, and planting of tree seedlings. The effects of these practices were examined. The results provide a measure of the effects of harvest and site preparation on soil erosion and water quality, an understanding of some hydrologic characteristics of small watersheds in the Ouachita Mountains, and a beginning point from which to evaluate soil loss models and erosion assessments for forestry. Clear-cut harvest and site preparation, including crushing the residual vegetation, burning, and contour ripping, were applied to three small watersheds in Oklahoma. Three undisturbed forested watersheds served as controls. First-year sediment losses averaged 282 and 36 kg/ha and storm flow water yields averaged 22.9 and 31/7 cm on clear-cut and uncut watersheds, respectively. The lower water yield on cut watersheds may have been due to contour ripping. Treatment differences in sediment yield were significant the second and third, but not the fourth, year following treatment. Storm flow water yield from clear-cut watersheds was significantly higher than from uncut watersheds the second year but not the third or fourth years. Absolute levels of sediment yield from clear-cut and control watersheds were relatively low in all years of the study. The overall impact of harvest and site preparation on total suspended solids levels in runoff was small and short-lived. (Murphy-IVI)
W84-04571

BED LOAD GRAIN VELOCITIES AND SEDIMENT TRANSPORT RATES,
State Univ. of New York at Binghamton. Dept. of Geological Sciences.
J. S. Bridge, and D. F. Dominic.
Water Resources Research, Vol. 20, No. 4, p 476-490, April, 1984. 6 Fig, 7 Tab, 109 Ref.

Descriptors: *Bed load, *Grain velocities, *Sediment transport, Fluid flow, Hydrodynamics, Mathematical equations.

When a fluid stream flows over a bed of loose sediment grains, fluid stresses at the sediment boundary may result in entraining of a finite number of grains, transporting them downstream. Theoretical consideration of the dynamics of bed load sediment transport leads to expressions for bed grain velocity and sediment transport rate. The grain velocity equation agrees well with all experimentally determined velocities of single grains moving over fixed rough beds if 'a' (a = 1)Karman constant ln (distance from boundary of effective fluid thrust on bed load grain)/roughness height) is allowed to vary with bed roughness and saltation height. Values of the critical shear velocity (at threshold of grain entrainment) for such overriding grains are substantially less than normally accepted values. The sediment transport rate equation predicts plane bed experimental data well, over five orders of magnitude of ib (ib = bed load transport rate as immersed weight passed per unit width). Values of 'a'/tan alpha increase significantly from lower to upper stage plane beds due to an increase in 'a' with suspended sediment concentration but also due to a decrease in tan 'a' with increasing transport stage and grain size (as predicted by Bagnold). (Murphy-IVI)
W84-04572

COAGULATION RATES OF CLAY MINERALS AND NATURAL SEDIMENTS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. J. Gibbs.
Journal of Sedimentary Petrology, Vol. 53, No. 4, p 1193-1203, December, 1983. 15 Fig, 2 Tab, 37 Ref.

Descriptors: *Coagulation, *Clay minerals, *Sediments, Illite, Kaolinite, Montmorillonite, Salinity, Mathematical models, Particle size, Environmental effects, Sedimentation.

Coagulation experiments conducted using illite, kaolinite, montmorillonite, and four natural sediment samples in blade and Couette reactors with solutions of various salinities yielded collison-efficiency factors significantly higher than those in the previous literature, indicating that coagulation begins at lower salinities (1/2-1%). The natural sediments do not generally behave as might be predicted for a mixture of the standards of the minerals of which the natural sediment samples were comprised. The half-times for coagulation of the particles indicate that, in nature, the coagulation process would probably be completed in the first few parts-per-thousand salinity. (Murphy-IVI)
W84-04608

TEMPORAL, SPATIAL, AND TEXTURAL VARIATIONS IN THE MINERALOGY OF MISSISSIPPI RIVER SUSPENDED SEDIMENT,
Amoco Production Co., New Orleans, LA.
A. G. Johnson, and R. T. Kelley.
Journal of Sedimentary Petrology, Vol. 54, No. 1, p 67-72, March, 1984. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Temporal variation, *Spatial variation, *Textural variation, *Mineralogy, *Mississippi River, *Suspended sediments, Sediments, Particle size, Smectite, Illite, Kaolinite, Quartz, Plagioclase, Alkali feldspar, Chlorite, Amphibole.

It has long been known that as a result of frequent deposition the mineralogy of Mississippi River sands remains constant in time and space along the river. There has never been a comparable, detailed mineralogical study of the vastly more abundant muddy sediment of the river. To evaluate the magnitude of variation in Mississippi River fine-fraction mineralogy, suspended sediment was collected at 3 stations across the river during July and November 1980. Samples were disaggregated, and without pretreatment, separated into 4 sizes: 62.5-7.8 micro m; 7.8-2.0 micro m; 2.0-0.49 micro m; and less than 0.49 micro m. Using calibration curves prepared from pure minerals with an internal standard, XRD determinations of the mineralogy were obtained with a high precision. Minerals quantified were, in order of decreasing abundance: smectite, illite, kaolinite, quartz, plagioclase, alkali feldspar, chlorite, and amphibole. The largest source of variation in suspensate mineral abundance was sediment size. Smectite, for example, comprised 50% of the fine clay, but was not present in silt. ANOVA revealed significant temporal variation in the abundance of smectite and illite within the finest size and lateral variation in quartz and feldspar abundance in coarser sizes. Discriminant function analysis determined that the total mineralogy of river-suspended sediment varied significantly with time. This temporal variation in mineralogy apparently results from differences in soil mineralogy in drainage basins of the major tributaries of the river, coupled with the time-varying contributions of the tributaries. (Author's abstract)
W84-04609

SEDIMENT COMPOSITION AND HYDROGRAPHY IN SIX HIGH-GRADIENT ESTUARIES OF THE NORTHWESTERN UNITED STATES,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2L.
W84-04610

PISTON CORERS FOR PEAT AND LAKE SEDIMENTS,
Minnesota Univ., Minneapolis. Limnological Research Center.
H. E. Wright, Jr., D. H. Mann, and P. H. Glaser.
Journal of Ecology, Vol. 65, No. 2, p 657-659, April, 1984. 2 Fig, 5 Ref.

Descriptors: *Piston corers, *Peat, *Lake sediments, Stratigraphy, Sedimentology, Measuring instruments, Design, Performance evaluation.

Investigations of peat stratigraphy usually involve the use of the Davis sampler, which is easy to operate because of its small diameter (approximately 2 cm), or the Hiller side sampler, which has a sharpened flange along its length by which a core is drawn into the chamber from the side. The Russian or Macaulay corer, also a side sampler, has become popular in recent years. Piston corers of 5-cm diameter, designed for lake sediments, have also been used. None of these devices is uniformly successful in cutting the wood or undecomposed fibrous peat that characterizes especially the upper meter or two of many peat deposits. The blade on a side sampler is not sharp enough to cut wood or sedge stems and rhizomes, and as the tube is rotated the blade may simply pull apart a few pieces of peat without obtaining a complete section. In the case of the usual 5 cm diameter piston sampler, the first few decimetres of undecomposed peat commonly form a plug that prevents further core recovery, and one must often resort to a shovel to obtain the upper peat. The corers described here are equipped with a serated cutting edge, along with modifications to permit the core tube to be rotated back and forth, so that undecomposed fibers and roots can be cut. Complete sections of peat and even the underlying silt or sand several meters deep can be acquired. The wide tube of the 10 cm diameter corer provides sufficient material for close-interval macrofossil and chemical analysis and for radiocarbon dating. The narrower corer is more portable and more convenient. Detailed guides to the operation of piston corers and related devices are described elsewhere (Wright 1983).
W84-04611

THE EROSIVE EFFECTS INDUCED BY BOAT PROPELLERS ON THE BOTTOM AND EMBANKMENTS OF WATERWAYS (EFFETS EROSIFS DES JETS D'HELICE DE BATEAU SUR LES FONDS ET LES TALUS DES VOIES NAVIGABLES),
Laboratoire National d'Hydraulique, Chatou (France).
J. P. Bouchard.
La Houille Blanche, Vol. 7/8, p 485-493, 1983. 4 Fig, 20 Ref.

Descriptors: *Erosion, *Boat propellers, *Bottom sediments, *Embankments, Mathematical equations, Waterways, Bank erosion, Erosion rates.

An analysis of investigations carried out on the effects of propeller jets has made it possible to deduce a general formula which is relatively diagrammatic but enables the diameter of the protective rockfill to be calculated according to the main characteristics of the boat. (Author's abstract)
W84-04651

THE MECHANICS OF MUD EROSION (MECANIQUE DE L'EROSION DES VASES),
Institut de Physique du Globe de Paris (France).
C. Perigaud.
La Houille Blanche, Vol. 7/8, p 501-512, 1983. 9 Fig, 6 Tab, 57 Ref.

Descriptors: *Erosion, *Mud, Mud-water interfaces, Turbulent flow, Unsteady flow, Varied flow, Flow profiles, Flow velocity, Sediments, Physical properties, Soil properties.

Muds react in a rheologically complex manner but these reactions can be diagrammatically summarized using various models. Muds of low concentration have the behavior of non-linear viscous fluids whereas highly concentrated muds exhibit a plastic threshold equivalent to the fracture of a solid. A current which erodes a mud can be simulated by a turbulent horizontal flow in which bursts play a crucial role. They periodically strike the water-mud interface and create stresses, the maximum force of which is well above the stress exerted by the average flow. Muds are eroded beyond a certain flow velocity, the so-called critical erosion velocity. Above this velocity erosion occurs intermittently because it is linked to the action of bursts. Muds of low concentration are eroded in the form of streamtubes which are carried away and then broken up by the flow. In the

case of highly concentrated muds little blocks of sediment are torn away and remain in the flow as small entities once they have been put into suspension again. (Author's abstract)
W84-04652

2K. Chemical Processes

MESOSCALE SPATIAL VARIABILITY OF SULFATE IN AIR AND RAINWATER AT ST. LOUIS,
Newcastle Univ. (Australia). Dept. of Geography.
H. W. Bridgman.
Water, Air, and Soil Pollution, Vol. 22, No. 2, p 153-172, 1984. 10 Fig, 1 Tab, 18 Ref. Department of Energy contract DE-AC02-76EV01199.

Descriptors: *Sulfate, *Rainwater, *Spatial variability, Water pollution sources, Chemistry of precipitation, Air pollution, Air pollution effects, St. Louis.

Sulfate concentrations in rainwater and in air measured on four summer days at St. Louis were highly variable, both spatially or temporally. Maximum/minimum ratios of aerosol SO4(2-) varied by up to a factor of 9, and those in rainwater by a factor of 3 on the average. Generally, SO4(2-) concentration patterns in air and rainwater were similar, and consistent with wind direction and the location of sources. Direct relationships between SO4(2-) in air and in water were evident on two of the individual days, but not for all days together. The non-uniformity of the SO4(2-) pattern plus consideration of possible sources of SO4(2-) suggests that nucleation of SO4(2-) particles must be a major cause of S scavenging, with some possible influence from sub-cloud impaction. (Author's abstract)
W84-04210

PRELIMINARY PLASMA SPECTROMETRIC ANALYSES FOR SELECTED ELEMENTS IN SOME GEOTHERMAL WATERS FROM CERRO PRIETO, MEXICO,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. W. Ball, and E. A. Jenne.
Available from the Ofss, USGS, Lakewood, CO 90225, Price: $1.50 paper copy, $3.50 microfiche. USGS Water Resources Investigations Report 83-4056, 1983. 9 p, 4 Tab, 2 Ref.

Descriptors: *Geothermal studies, *Trace metals, *Emission spectroscopy, Geothermal resources, Effluents, Metals, *Mexico, Cerro Prieto, Multielement analysis, Spectral interferences.

As part of a cooperative study with Dr. Alfred Truesdell, water samples collected from geothermal power production wells at Cerro Prieto, Mexico, were analyzed for selected elements by d.c. argon plasma emission spectroscopy. Spectral interferences due to the presence of high concentrations of Ca, Si, Na and K in these water affected the apparent concentration values obtained. These effects were evaluated and correction techniques were developed and applied to the analytical values. Precipitates present in the samples at the time of analysis adversely affected the accuracy, precision and interpretability of the data. (USGS)
W84-04263

RADIUM AND BARIUM IN THE AMAZON RIVER SYSTEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
W. S. Moore, and J. M. Edmond.
Journal of Geophysical Research, Vol. 89, No. C2, p 2061-2065, March 20, 1984. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Rivers, *Chemical reactions, *Radium, *Barium, *Amazon River, Weathering, Fractionation, Uranium, Thorium, Model studies, Radioisotopes.

The isotopes of radium exist in natural waters largely unsupported by decay of their immediate parents in solution. Continuous production and release of radium isotopes from their long-lived parents in solid phases supports the activities measured in the aqueous phase. Thus, the relative abundance of Ra isotopes in rivers should be an index of the distribution of U and Th in solid phases in the drainage basin. Fundamental data is provided on the radium isotope content of the largest river in the world, the Amazon, as well as its tributaries. These data enable estimates to be made of the dissolved fluxes of Ra-226 and Ra-228 to the ocean and to investigate possible fractionation of U and Th in the Amazon basin. Based on the Ra isotope content of the rivers and the Ra/Ba ratios, it is concluded that little fractionation of U and Th has occurred within the basin during weathering. The Ra-226 data fit a flux model for the major ions indicating that Ra-226 behaves conservatively along the main channel of the Amazon River. (Baker-IVI)
W84-04296

THE CHEMISTRY OF THE SEVERN ESTUARY AND THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-04335

TIME-VARIANT DIFFERENCES IN CHEMISTRY AMONG FOUR SMALL STREAMS,
For primary bibliographic entry see Field 2H.
W84-04359

DISSOLVED INORGANIC SUBSTANCES, A STUDY OF MASS BALANCE IN THREE SMALL DRAINAGE BASINS,
Uppsala Univ. (Sweden). Dept. of Hydrology.
U. M. Calles.
Hydrobiologia, Vol. 101, No. 1/2, p 13-18, April, 1983. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Dissolved inorganic matter, *Dissoved solids, Chemical properties, Deposition, Salinity, Catchment areas, Velen basin, Kassjoan basin, Lapptrasket basin.

During the International Hydrological Decade (IHD) three drainage basins were selected as being representative for Swedish forest areas. These basins were Velen, Kassjoan and Lapptrasket. Although the Representative Basin Project ended in 1975 investigations have been continued in some of the sub-basins. This paper is based on data from three sub-basins within Lapptrasket and Kassjoan. Investigations were carried out on chemical composition of runoff and precipitation in order to compute the balance of analyzed ions. Annual transports were computed using one analysis per month and monthly mean discharge of water. Since the chloride content of the bedrock is very low all the discharged chloride is regarded as being of atmospheric origin. This assumption has been used for the calculation of balance. Computed balances show a deposition of sulphur that exceeds the amount of sulfur discharges. Cations show a discharge that exceeds deposition in all investigated basins. (Author's abstract)
W84-04696

COMPLEXATION OF COPPER BY AQUATIC HUMIC SUBSTANCES FROM DIFFERENT ENVIRONMENTS,
Geological Survey, Denver, CO.
D. M. McKnight, G. L. Feder, E. M. Thurman, R. L. Wershaw, and J. C. Westall.
The Science of the Total Environment, Vol. 28, p 65-76, June, 1983. 1 Fig, 4 Tab, 17 Ref.

Descriptors: *Humic substances, *Copper, *Complexation, Computers, Organic carbon, Chemical speciation, Bioavailability, Equilibrium constant, Path of pollutants, Natural waters.

The copper-complexing properties of aquatic humic substances isolated from eighteen different environments were characterized by potentiometric titration, using a cupric ion selective electrode. Potentiometric data were analyzed using FITEQL, a computer program for the determination of chemical equilibrium constants from experimental data. All the aquatic humic substances could be modelled as having two types of Cu(II)-binding sites: one with K equal to about 1,000,000 and a concentration of 1.0 + or - 0.4 x 10 to the -6th M/(mg C) and another with K equal to about 10 to the 8th and a concentration of 2.6 + or - 1.6 x 10 to the -7th M/(mg C). A method is described for estimating the Cu(II)-binding sites associated with dissolved humic substances in natural water based on a measurement of dissolved organic carbon, which may be helpful in evaluating chemical processes controlling speciation of Cu and bioavailability of Cu to aquatic organisms. (Author's abstract)
W84-04740

QUANTITATION OF METAL COMPLEXES BY REVERSE-PULSE AMPEROMETRY AND MOLECULAR-EXCLUSION CHROMATOGRAPHY,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
M. L. Adamic, and D. E. Bartak.
Analytica Chimica Acta, Vol. 158, No. 1, p 43-55, April, 1984. 6 Fig, 1 Tab, 30 Ref, OWRT grant B-057-NDAK.

Descriptors: *Metal complexes, *Complexing agents, Amperometry, Chromatography, Trace metals, Binding agents, Copper, Fulvic acids, EDTA, Trace metals.

Quantifying metal-binding or complexing agents in aqueous environments is important, since the binding agents will affect the chemical speciation of trace metals, which ultimately determines the reactivity, transport, and biological availability of the metal. Two important factors which should be known are the nature of the binding agent and the binding agent concentration. An electrochemical flow cell in conjunction with modified molecular-exclusion chromatographic techniques is used to identify and quantify a series of copper complexes. A reverse-pulse amperometric mode is used to quantify the complexes and to minimize oxygen interference. The chromatographic eluent is modified by 'buffering' with copper(II) to prevent dissociation of labile complexes. A Sephadex G-25 column resolves a mixture of copper complexes of polyaminocarboxylic acids. A detection limit of 0.65 micro g was obtained for the Cu-EDTA complex. Copper(II)-citrate complexes were well resolved on the Sephadex column as a dimeric complex with a detection limit of 1.0 micro g. Fulvic acid complexes of copper were quantified with the above techniques upon elution from a Sephadex G-15 column. A detection limit of 5 micro g was found for a copper-fulvic acid complex. EDTA can be quantified in the presence of fulvic acid by these techniques. The technique is potentially useful in the determination of complexation capacities in water systems. (Moore-IVI)
W84-04770

2L. Estuaries

HYDRODYNAMICS OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles.
Marine Pollution Bulletin, Vol. 15, No. 2, p 47-53, February, 1983. 8 Fig, 40 Ref.

Descriptors: *Channels, *Hydrodynamics, *Bristol Channel, *England, Fluid mechanics, Tidewaters, Tides, Water currents, Tidal currents, Vertical flow, Salinity.

The most obvious feature of the circulation in the Bristol Channel is the oscillatory tidal current. Indeed the tides were involved in the earliest attempts to describe circulation within the Channel. Much of the more recent work has been concerned with the possible effects of a barrage on the tidal regime. Both tidal and residual currents are used to review what is known of the effects of tidal stress on the sea bed, and on vertical mixing, as well as discerning their effects on dispersion of salt and other solutes. Tides in the Bristol Channel are predominantly semidiurnal with the largest compo-

ent being the principal lunar tide. Tidal and resid-al currents produce a frictional drag on the sea ed (tidal stress). Large tidal stresses are associated vith strong vertical current shear which generates ntense vertical mixing. By fitting logarithmic or /an Veen profiles of velocity to observed maxi-num flood and ebb currents, the vertical eddy iscosity can be estimated. A time-scale for the ertical mixing of a passive tracer released at the urface can be derived by assuming that the verti-al eddy diffusivity and viscosity are equal in the omogeneous water of the Channel. Salinity com-uted from a coarse-grid, two-dimensional model nd observed salinity are compared over several ears for six large regions. The agreement between bserved and predicted salinity is reasonable. Baker-IVI)
W84-04333

EDIMENTATION PROCESSES IN THE BRIS-OL CHANNEL/SEVERN ESTUARY,
nstitute of Oceanographic Sciences, Taunton England).
K. R. Dyer.
Marine Pollution Bulletin, Vol. 15, No. 2, p 53-57, February, 1984. 4 Fig, 29 Ref.

Descriptors: *Estuaries, *Sedimentation, *Sedi-nent transport, *Bristol Channel, *Severn Estuary, England, Distribution, Fate of pollutants, Tidal ffects, Tidal prism.

The Bristol Channel and Severn Estuary together orm a wide, shallow estuary with a large tidal ange and strong currents. The residual current low in the Bristol Channel has been modelled sing a vertically integrated scheme which indicat-d a general westerly residual current, with a lockwise circulation in Swansea Bay and west of Nash Point. The sediment distribution and sedi-nent budgets in the Inner Bristol Channel and Severn Estuary are reviewed with discussions on oth sandy and muddy sediment and its transport. The system is more or less in balance in the subti-dal prism in the estuary above the Holms and any urther sediment input would be deposited outside he Holms. The major sediment supply seems to be f fine-grained material from the rivers, but be-cause of the very high tidal energy, the existing ediments are continually being reworked and re-distributed. Any major alteration of the topogra-hy or the tidal regime would disrupt this regime. Because of the large quantity of fine sediment in notion and its affinity for pollutants it is important o understand the processes by which the high concentrations settle, erode and mix. (Baker-IVI)
W84-04334

THE CHEMISTRY OF THE SEVERN ESTU-ARY AND THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris.
Marine Pollution Bulletin, Vol. 15, No. 2, p 57-61, February, 1984. 2 Fig, 33 Ref.

Descriptors: *Estuaries, *Chemical reactions, *Bristol Channel, *Severn Estuary, *England, Oxygen, Nutrients, Temperature effects, Seasonal variations, Metals, Salinity, Particulates.

The occurrence of an oxygen sag in the upper reaches of the Severn Estuary, especially under summer conditions of low flow and high tempera-ture, has not been fully characterized. The waters of the Severn Estuary and Bristol Channel do not constitute a simple two-component mixing gradient between the primary river input and offshore waters. The Severn River supplies only about a quarter of the total freshwater input to the system. Concentrations of some nutrients and metals within the Inner and Outer Severn Estuary are plotted against salinity. Some dissolved constituents do show synoptic linear relationships with salinity within this part of the estuary, either consistently or at certain times. The combination of widely distributed sources, temporal variability in anthro-pogenic inputs and, especially for the nutrients, seasonal variability in riverine concentrations, cou-pled with the long estuarine flushing time, severely restricts the use of synoptic distribution of dis-solved constituents for qualitative and quantitative deductions concerning chemical behavior within the waters of the Inner and Outer Severn Estuary. The estuary has a very large capacity for assimilat-ing particulate contaminants and this generally ob-viates the use of particulate compositions and their spatial characteristics for elucidating aspects of chemical reactivity within the Severn Estuary. (Baker-IVI)
W84-04335

THE MICROBIAL ECOLOGY OF THE BRIS-TOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
I. R. Joint.
Marine Pollution Bulletin, Vol. 15, No. 2, p 62-66, February, 1984. 5 Fig, 17 Ref.

Descriptors: *Ecology, *Microorganisms, *Bristol Channel, *England, Estuarine environment, Estu-aries, Phytoplankton, Turbidity, Metals, Iron, Water pollution effects.

Bristol Channel is considered as being divided into 7 geographical regions, some of which have very high suspended solids concentrations. Turbidity varies with tidal state and with season. The shal-lowness of the euphotic layer has a considerable influence on phytoplankton ecology in the Chan-nel. Recent studies have derived time-scales for vertical mixing and discuss the importance of this process to phytoplankton ecology. Although the phytoplankton of the Channel are light-limited, they are unlikely to be limited by nutrients. The major source of dissolved organic carbon (DOC) to the Channel is riverine. DOC shows a conserva-tive mixing behavior in the Channel and a large proportion must be refractory and is not utilized by heterotrophic microbes. While there was a strong correlation between heterotrophic potential and turbidity, the highest activity did not always occur at times of highest turbidity. The reported levels of zinc and copper in the Channel are greater than those which inhibit photosynthesis. How-ever, it is arguable whether heavy metals are limit-ing phytoplankton production. The turbidity is so great in many areas that phytoplankton is severely light-limited and heavy metal inhibition may not significantly affect the already limited photosyn-thesis. (Baker-IIV)
W84-04336

THE BENTHIC ECOLOGY OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
R. M. Warwick.
Marine Pollution Bulletin, Vol. 15, No. 2, p 70-76, February, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Benthic environment, *Bristol Chan-nel, *England, *Benthos, Population dynamics, Tidal effects, Fauna, Distribution, Simulation, Tidal effects, Currents.

The factors underlying the distribution, structure and functioning of benthic communities and the interactions between the benthos and other compo-nents of the ecosystem were examined in the Bris-tol Channel. Samples of the bottom fauna were taken on a grid of 155 stations in the Channel from Lundy Island to just above the Holme Islands. The inner part of the Channel is a zone of erosion with a rock bed. In the eastern Bristol Channel, the bed types of Bridgwater Bay and the lower Severn estuary are governed by extremely dense suspen-sions of particulate material maintained in the water column by the strong tidal currents. The influence of high current speeds and the associated stress on the sea bed result in a reduced hard-bottom fauna in the upper part of the channel. Each community subdivision found in the Channel has its center of distribution at a particular bed stress value. These relationships were used to com-pile an idealized simulation of the distribution of faunal types on the assumption that they relate directly to tidal stess, with no overlap between. At present the observed properties of community structure and function are explicable in terms of natural forcing functions, of which current speed is the most important, rather than resulting from pollution of the water. (Baker-IVI)
W84-04337

LEAD CYCLING IN ESTUARIES, ILLUSTRAT-ED BY THE GIRONDE ESTUARY, FRANCE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
For primary bibliographic entry see Field 5B.
W84-04338

VARIABILITY AND FLUXES OF NITROGEN AND ORGANIC CARBON AT THE MOUTH OF A COASTAL LAGOON,
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico). Div. of Oceanology.
B. C. Farfan, and S. Alvarez-Borrego.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 599-612, December, 1983. 4 Fig, 2 Tab, 35 Ref.

Descriptors: *Coastal lagoons, *Nitrogen, *Organ-ic carbon, *San Quentin Bay, *Mexico, *Tidal effects, Heat, Nutrients, Productivity, Detritus, Upwelling, Dinoflagellates, Zooplankton, Sea-grass.

This work examines the tidal exchanges of heat, inorganic nitrogenous nutrients and various forms of organic matter at the mouth of San Quentin Bay, Baja California, Mexico. It also attempts to elucidate the main factors responsible for the short-term fluctuations of these seawater properties. To accomplish this, a time series sampling was carried out at the mouth of the bay from 25 June to 5 July, 1979. The bay systematically exported heat, with an average of 1.2 x 10 to the 10th kcal per half tidal cycle during the sampling period. Inputs of nitrite and nitrate during upwelling were of major impor-tance to the productivity of the lagoon. During non-upwelling conditions the trend was toward a dynamic equilibrium in the oxidized inorganic nu-trient fluxes. There were significant exports of ammonia. These ammonia exports were, on aver-age, about 20% of the nitrate plus nitrate imports. Ammonia concentrations were related to metabol-ic and mixing processes. Ammonia might be an important export product throughout the year, as a result of the reduced state of the sediments. During the sampling, there were imports of particulate organic carbon and nitrogen. The C/N ratio sug-gests that the main origin detritus was other than the breakdown of eelgrass in the bay. There were mostly imports of diatom carbon, but fluxes of dinoflagellate carbon were always near equilibri-um. Zooplankton showed both exports and im-ports. Variability in the zooplankton carbon was mostly related to diel vertical migration. There were no significant exports of floating seagrass, not even during spring tides. (Author's abstract)
W84-04366

NUTRIENT FLUX IN THE RHODE RIVER: TIDAL EXCHANGE OF NUTRIENTS BY BRACKISH MARSHES,
Smithsonian Institution, Edgewater, MD. Chesa-peake Bay Center for Environmental Studies.
T. E. Jordan, D. L. Correll, and D. F. Whigham.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 651-667, December, 1983. 5 Fig, 7 Tab, 38 Ref.
NSF grant DEB 7911563.

Descriptors: *Nutrient cycling, *Tidal effects, *Brackish marshes, *Rhode River, *Maryland, Ni-trogen, Phosphorus, Organic carbon, Bulk precipi-tation, Mudflats, Estuarine environment, Particu-lates.

Tidal exchange of nitrogen, phosphorus, and or-ganic carbon by a high and a low elevation marsh in the Rhode River estuary were measured throughout the year. Both marshes tended to import particulate matter and export dissolved matter, although they differed in the fluxes of certain nutrients. Compared with tidal exchanges, bulk precipitation was a major source of ammonia and nitrate and a minor source of other nutrients. There was a net retention of nutrients by the portion of the Rhode River that included both

marshes and a mudflat. However, the marshes accounted for only 10% of the phosphorus retention and 1% of the nitrogen retention while they released organic carbon amounting to 20% of the retention. This suggests that the mudflat acted as a sink for nutrients. The primary role of the marshes seems to be transformation of particulate to dissolved nutrients rather than nutrient retention or release. (Author's abstract)
W84-04367

NUTRIENT FLUX IN THE RHODE RIVER: TIDAL TRANSPORT OF MICROORGANISMS IN BRACKISH MARSHES,
Smithsonian Institution, Edgewater, MD. Chesapeake Bay Center for Environmental Studies.
P. A. Rublee, S. M. Merkel, and M. A. Faust.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 669-680, December, 1983. 4 Fig, 3 Tab, 42 Ref. NSF grant DEB 7911563.

Descriptors: *Tidal effects, *Brackish marshes, *Microorganisms, *Rhode River, *Maryland, *Nutrients, Bacteria, Chlorophyll a, Organic compounds, Estuarine environment.

Concentrations of bacteria, chlorophyll a, and several dissolved organic compounds were determined during 11 tidal cycles throughout the year in a high and a low elevation marsh of a brackish tidal estuary. Mean bacterial concentrations were slightly higher in flooding (7,100,000 cells/ml) than in ebbing waters (6,500,000 cells/ml), and there were no differences between marshes. Mean chlorophyll a concentrations were 36.7 microg/l in the low marsh and 20.4 microg/l in the high marsh. Flux calculations, based on tidal records and measured concentrations, suggested a small net import of bacterial and algal biomass into both marshes. Over the course of individual tidal cycles, concentrations of all parameters were variable and not related to tidal stage. Heterotrophic activity measured by the uptake of H-3-thymidine, was found predominantly in the smallest particle size fractions (less than 1.0 um). Thymidine uptake was correlated with temperature (r=0.48, P less than 0.01), and bacterial productivity was estimated to be 7 to 42 microg C/l/day. (Author's abstract)
W84-04368

NATURAL ISOTOPIC COMPOSITION OF NITROGEN AS A TRACER OF ORIGIN FOR SUSPENDED ORGANIC MATTER IN THE SCHELDT ESTUARY,
Paris-6 Univ. (France). Lab. de Geophysique Appliquee.
A. Mariotti, C. Lancelot, and G. Billen.
Geochimica et Cosmochimica Acta, Vol. 48, No. 3, p 549-555, March, 1984. 8 Fig, 3 Tab, 31 Ref.

Descriptors: *Isotope studies, *Suspended sediments, *Estuaries, Estuarine environment, Scheldt estuary, Nitrogen, Ammonia, Nitrification, Phytoplankton, Seasonal variation, North Sea, Seas.

The natural isotopic composition of suspended particulate organic nitrogen was determined in the Southern Bight of the North Sea and in the Scheldt estuary, and proved to be a useful tracer to determine origin of suspended organic matter. The data presented show the very important seasonal variability of the isotopic composition of suspended nitrogen and the complexity of the interrelated processes controlling them. In the winter, in the absence of intensive primary production, the suspended organic matter was a mixture of two components: a continental detrital component and a marine component. During the phytoplankton flowering period intensive primary production occurred throughout the estuary giving rise to a third source of organic matter. Simple isotopic budget calculations show that, both in the upstream part and in the downstream part, autochthonous phytoplanktonic material contributes a major part of the total suspended matter in the Scheldt estuary during summer. (Baker-IVI)
W84-04380

THE EFFECT OF MACROPHYTE REMOVAL ON THE DISTRIBUTION OF SELECTED INVERTEBRATES IN A LITTORAL ENVIRONMENT,
Idaho Univ., Moscow. Dept. of Biological Sciences.
F. W. Rabe, and F. Gibson.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 359-371, April, 1984. 3 Fig, 5 Tab, 27 Ref.

Descriptors: *Littoral environment, *Macrophytes, *Vegetation effects, Phytoplankton, Habitats, Wetlands, Zooplankton.

Submerged vegetation was removed from four locations in a shallow wetland lake containing a dense concentration of aquatic macrophytes. The distributions of selected species of zooplankton and macroinvertebrates were compared over a two month period between the vegetated sites and locations in which vegetation was removed. A major difference was the relative numbers of Daphnia schodleri and small species of cladocerans. These small microcrustaceans were clearly more abundant than D. schodleri at vegetated sites. Early in the study Daphnia was collected most frequently in deep water. However, later in the season it was sampled most commonly in the shallow sites. The shift of Daphnia to these sites coincided with decreasing plant biomass in the shallow water due to senescence and waterfowl foraging. The small cladocerans showed an opposite shift to deeper water where macrophyte density was greater. Phytoplankton were more dense in vegetated sites than denuded ones and species composition was similar in both. (Baker-IVI)
W84-04384

SALTMARSHES OF THE UPPER FORTH ESTUARY,
J. Proctor, M. W. Fraser, and J. Thompson.
Botanical Society of Edinbourgh Transactions, Vol. 44, Part 2, p 95-102, 1983. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Estuaries, *Saltmarshes, *Vegetation, *Upper Forth Estuary, *Scotland, Puccinellietum, Juncetum, Marshes, Topography, Salinity.

The extent of the saltmarshes in the Upper Forth has diminished greatly, largely due to land reclamation efforts in the eighteenth and nineteenth centuries and the facts of erosion currently. The vegetation along 15 transects from different marshes is described and classified. One of the quadrants contained no vegetation and the remaining 149 were initially classified by computer using a polythetic divisive method. Although there are some special features, the vegetation is generally poor in species and communities. The majority of the samples fall clearly within the two most common and widespread associations on British saltmarshes: Puccinellietum maritmae or Juncetum gerardi. One of the most likely causes of this poverty is the great disturbance and reduction in area associated with reclamation. Most of the existing saltmarshes occur as a strip 5 to 80 m wide in front of the sea wall. The grazing history of the saltmarshes is unclear. The distribution of the halophytic plants can be related to the salinity of the upper estuary but this is very variable and depends on many factors. (Baker-IVI)
W84-04389

SALINITY AND TEMPERATURE EFFECTS ON PHOTOSYNTHESIS AND ORGANIC CARBON RELEASE RATES BY SELECTED BENTHIC MACROALGAE,
Connecticut Univ., Storrs. Inst. of Water Resources.
C. Yarish, and M. Heller.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-163146, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September, 1983. 51 p, 4 Fig, 12 Tab, 105 Ref. Project No. OWRT A-091-CONN(1), Contract/Grant No. 14-34-0001-2107.

Descriptors: *Food chains, *Benthic flora, *Algae, Estuarine environment, *Photosynthesis, *Salinity, *Temperature, *Organic carbon, Algal growth water, Radioactivity, Water pollution effects.

Estuarine benthic macroalgae are excellent producers of new carbonaceous material through their high rates of photosynthesis. Under some circumstances, this organic carbon is liberated into the aquatic environment in dissolved form while the plant is actively photosynthesizing. This project established a protocol for examining the effects of different combinations of salinity, temperature, and emergence/submergence regimes, determined the effects of antibiotics on the photosynthetic rate, and the extent to which these factors effect liberation of organics by selected estuarine benthic macroalgae. In establishing the preoperational procedures, the following determinations were made: 1) To reduce organic carbon background contamination to the lowest possible level, a 1.0h to 1.5h of ultraviolet radiation of the seawater and distilled/deionized water used in the media preparation was needed, 2) A level of 10uCi was required to allow adequate uptake and detection of released products, 3) Since bacterial contamination would mask released organic carbon, antibiotics were included in the media. It was found, however, that even at the lowest level, algal production rates were markedly reduced while the organic carbon release-rates were greater than that observed for the controls, 4) At the level of added radioactivity (10uCi), at least 15 min of bubbling was necessary to achieve acceptable background values. This assay was performed to preclude interference by radioactive inorganic carbon when determining the amount of organic carbon released by the test species, 5) It was found that the level of inorganic C-14 released from an aqueous solution by acidification and bubbling is extremely time dependent.
W84-04407

MICROELEMENTS IN POLDERS OF THE NEMAN RIVER DELTA,
M. M. Ermolayev, and V. E. Ryaboi.
Soviet Soil Science, Vol. 15, No. 2, p 63-69, 1983. 3 Tab, 11 Ref. Translated from Pochvovedeniye, No. 2, p 49-55, 1983.

Descriptors: *Polders, *Deltas, *Chemical analysis, *Neman River, *USSR, Trace elements, Groundwater, Meadows, Peat bogs, Soil types.

Data are presented concerning the content of microelements in parent rocks, meadow coenoses and soil ground waters in the polders of the Neman river delta. The soil forming rocks of the Neman river delta are characterized by a great diversity of microelement content which is due to lithological heterogeneity of the rocks. The higher concentration of microelements is a characteristic of glaciers and old alluvial clay and loam. The old alluvial and aeolian sands are poor in microelements with the exception of titanium and beryllium. Soil developed on old alluvial depositions has the highest concentration of fluorine, strontium, zinc, cobalt, and copper. Biogenic accumulation of different chemical elements has been observed in peat-bog soils. Cultivated soils contain greater amounts of many different chemical elements than do uncultivated and poorly cultivated soils. In the process of particle differentiation, accumulation of manganese, zinc, cobalt, nickel, copper and chromium occurs in the minute dispersed materials. In sand and coarse dust particle fractions, titanium, barium, and strontium mainly concentrate. The amount of accumulation depends strongly on the soil type, soil horizon and composition of the soil forming rocks. Very low content of cobalt and molybdenum were found which is common for the meadow vegetations of the polders of the Neman river delta. In the soil ground water of old alluvial and peat-bog depositions, relatively high concentrations of manganese, copper, zinc, fluorine, boron and very rare cobalt and nickel have been observed. The two-way regulation of water regime of the polders intensifies copper and zinc removal by the ground water from superaqueous landscapes. (Baker-IVI)
W84-04521

ORGANIC CARBON AND SULFUR IN THE SEDIMENTS OF THE VIRGINIA CHESAPEAKE BAY,

William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
C. H. Hobbs, III.
Journal of Sedimentary Petrology, Vol. 53, No. 2, p 383-393, June, 1983. 7 Fig, 1 Tab, 26 Ref. EPA Grant R806001010.

Descriptors: *Sediments, *Chesapeake Bay, *Virginia, Mobjack Bay, Tangier Sound, Hampton Roads, Industrial wastes, Bacteria, Organic carbon, Sulfur, Clay, Chemical reactions.

A strong relationship was determined between the clay content and the organic-carbon and sulfur contents of the sediments of the lower Chesapeake Bay. Organic carbon and sulfur contents of 900 sediment samples from the Virginia portion of the Bay averaged 1.0% and 0.35%, respectively. This relationship is probably a result of the great surface area presented by a large volume of clay particles and of the chemically active nature of the clays. Generally the relationship of organic carbon and sulfur within the sediments is strong, which reflects sulfate reduction by bacteria with organic carbon serving as food for the bacteria. Several subareas of the Bay are affected by different processes which, in turn, influence the sedimentological and chemical relationships. The urban, industrial surroundings of Hampton Roads create an environment quite different from that in Tangier Sound or Mobjack Bay. The volume of fresh-water inflow, the nature of the drainage basin, and the local energy-regime, in the form of waves and currents, all contribute to local variations. (Baker-IVI)
W84-04606

RESPONSE CHARACTERISTICS OF AN EBB-DOMINATED TIDAL INLET CHANNEL,
Boston Univ., MA. Dept. of Geology.
D. M. Fitzgerald, and D. Nummedal.
Journal of Sedimentary Petrology, Vol. 53, No. 3, p 833-845, September, 1983. 10 fig, 5 Tab, 25 Ref. Army Research Office grant DAAG-29-76-6-0111.

Descriptors: *Ebb-tidal inlet channel, *Channels, *Tides, Tidal hydraulics, Tidal basins, Tidal currents, Price Inlet, South Carolina.

A three-year study (July 1974 to 1977) of Price Inlet, South Carolina, monitored inlet hydraulics and channel morphology. The inlet is strongly ebb-dominant. Both the peak and mean current velocities during ebb exceed the corresponding velocities during flood. The velocity asymmetry is caused by changes in inlet efficiency during the tidal cycle. The intertidal marsh of the Price Inlet drainage area experiences a change in open water surface area of about 670 percent during an average tidal cycle. At high tide, the large water surface of the marsh is responsible for inefficient exchange of water through the inlet. This causes a long time lag between ocean and bay tides. The small surface area of open water in the marsh at low tide, on the other hand, yielded nearly no time lag. These differential time lags cause longer flood durations than ebb durations in the inlet throat and consequently, stronger ebb velocities. Monitoring of the cross-sectional flow area of the inlet throat demonstrates rapid adjustment to changing flow conditions. The 1159 sq m cross sectional area of the inlet throat varied as much as 8.3% during one tidal cycle. The cross sectional area varied in phase with the tidal range. Long-term changes in the dimensions of the channel appear to be a direct result of changes in the size of ebb-tidal delta shoals. During the study period, the growth of the linear bars in the channel margin gradually reduced wave energy along the inlet shoreline and on the inner ebb-tidal delta platform. This in turn reduced sediment transport into the inlet, which resulted in a gradual increase in the cross-sectional area of the channel. Seasonal fluctuations in mean sea level appear to have little effect on the inlet channel. (Author's abstract)
W84-04607

SEDIMENT COMPOSITION AND HYDROGRAPHY IN SIX HIGH-GRADIENT ESTUARIES OF THE NORTHWESTERN UNITED STATES,
Oregon State Univ., Corvallis. School of Oceanography.
C. Peterson, K. Scheidegger, P. Komar, and W. Niem.
Journal of Sedimentary Petrology, Vol. 54, No. 1, p 86-97, March, 1984. 6 Fig, 2 Tab, 37 Ref. Department of Commerce project P/CP-3, grant 04-7-158-44-85.

Descriptors: *Sediment composition, *Hydrography, *Estuaries, *Northwest, *United States, Sedimentation, Sediment transport, Particle size, Deposition, Sediment yield.

Small estuaries of the northwestern United States are fed by high-gradient streams which range widely in mean fluvial-discharge rates. Sediment composition in these estuaries differs with grain size and with the relative abundances of river-and beach-derived sand. In order to determine to what degree sediment composition is related to the relative influence of tidal and river flow in these active-margin estuaries, the modern sediment compositions in six Pacific Northwest estuaries were analyzed by standard grain-size and heavy-mineral techniques. The average textural and sand-source compositions are compared and found to be correlated with a hydrographic parameter HR (mean tidal-prism volume: mean fluvial discharge rate x 6 hours) computed for each bay. Both % mud and % beach sand increase as the dimensionless hydrographic ratio (HR) increases. Unusual results in two of the estuaries are attributed to man-made alterations in one estuary and to eolian transport of beach sand into the other estuary. (Author's abstract)
W84-04610

WETLAND IMPACT ASSESSMENT: PROBLEMS UNDER THE CLEAN WATER ACT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
For primary bibliographic entry see Field 6G.
W84-04612

TEMPORAL OCCURRENCE OF ICHTHYOPLANKTON IN RELATION TO HYDROGRAPHIC AND BIOLOGICAL VARIABLES AT A FIXED STATION IN THE ST LAWRENCE ESTUARY,
Quebec Univ., Rimouski. Dept. of Oceanography.
Y. de Lafontaine, M. Sinclair, M. I. El-Sabh, C. Lassus, and R. Fournier.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 177-190, 1984. 5 Fig, 7 Tab, 54 Ref.

Descriptors: *Ichthyoplankton, *Hydrography, Biological properties, St. Lawrence estuary, Temporal distribution, Spatial distribution, Hydrologic aspects, Tidal hydraulics, Tides.

Spring to autumn temporal distributions of ichthyoplankton and other oceanographic variables were measured at three nearshore stations in the lower St Lawrence Estuary in 1977 and 1978. The seasonal occurrence of various species of fish eggs and larvae was similar from one year to the next. Inshore-offshore gradients in abundance of eggs and larvae of different species appeared to be primarily related to the spawning location of each species. The semidiurnal variability was considerably less than the week-to-week variability in all physical and biological variables measured. The weekly variability is predominantly a function of spatiotemporal interactions, due to the geographic displacement of different water masses and their associated plankton in relation to the neap-spring tidal cycle. The timing and duration of spawning for each common species, inferred from ichthyoplankton distributions, suggest a unique combination of spawning and hatching times, ensuring a succession in the occurrence of larvae through time. Results of the temporal and spatial distributions of the different species of ichthyoplankton are discussed in terms of reduced competitive interactions. The relationship between ichthyoplankton distributions and the plankton production cycle in the St Lawrence Estuary is discussed in comparison with other areas. (Author's abstract)
W84-04633

BENTHIC NUTRIENT REGENERATION IN SOUTH TEXAS COASTAL WATERS,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint, and D. Kamykowski.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 2, p 221-230, February, 1984. 4 Fig, 2 Tab, 31 Ref. Bureau of Land Management contract AA551-CT8-51.

Descriptors: *Benthic environment, *Cycling nutrients, *Texas, *Coastal waters, Nutrients, Phytoplankton, Mud-water interfaces, Benthic fauna, Nutrient removal, Primary production.

Because of the unpredictable nature of many potential nutrient sources for coastal phytoplankton primary production needs in the north-western Gulf of Mexico, benthic regeneration was investigated as a more constant source of nutrients to this ecosystem. Water column ammonia profiles taken at several locations on the south Texas inner-shelf in the last seven years showed peak concentrations in bottom waters. Benthic chamber measurements verified the presence of ammonia fluxes at the mud-water interface in south Texas coastal waters. These fluxes were related to benthic faunal activity as measured by sediment metabolism. Laboratory experiments, designed to test the effect of benthic faunal removal on nutrient regeneration, suggested that the fauna play a role in regulating this process. How this regulation may occur is discussed. Estimated annual benthic regeneration rates can supply 69% of the nitrogen required to support phytoplankton primary production in these coastal waters. (Murphy-IVI)
W84-04634

THE EFFECT OF CHRONIC OIL POLLUTION ON SALT-MARSH NITROGEN FIXATION (ACETYLENE REDUCTION),
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
A. D. Thomson, and K. L. Webb.
Estuaries, Vol. 7, No. 1, p 2-11, March, 1984. 2 Fig, 5 Tab, 39 Ref.

Descriptors: *Oil pollution, *Salt Marshes, *Nitrogen fixation, Acetylene, Virginia, Sediments, Bioaccumulation, Environmental effects, Nitrogen.

Annual acetylene reduction rates associated with intertidal communities in a chronically oil polluted Virginia salt marsh were compared to rates measured in an undisturbed marsh. Chronic oil treatment resulted in visible damage to the higher plants of the Spartina alterniflora zones; however, vegetation-associated acetylene reduction was not different from the untreated control. Sediment rates generally were affected little by oil application, except during the summer when rates in the median tidal elevation zones were considerably higher than those of the control. Acetylene reduction occurred in all transects, each of which extended from upper mudflat to the Spartina patens zone. Intertidal sediment acetylene reduction was patchy, both spatially and seasonally. Estimated rates were greater near the surface; free-living bacterial N2 fixation activity averaged 2.23 mg N per sq m per d (range = undetectable to 365 mg N per sq m per d) in the untreated and 3.17 mg N per sq m per d (range = undetectable to 564 mg N per sq m per d) in the oil-treated marsh during the year. Vegetation-associated N2 fixation activity yielded highest overall mean rates (156 mg N per sq m per d). The seasonal pattern of sediment and vegetation-associated fixation may be controlled by temperature and availability of oxidizable substrates. (Author's abstract)
W84-04669

EFFECTS OF DREDGING AND OPEN-WATER DISPOSAL ON BENTHIC MACROINVERTEBRATES IN A SOUTH CAROLINA ESTUARY,
South Carolina Wildlife and Marine Resources Dept., Charleston. Marine Resources Research Inst.
For primary bibliographic entry see Field 5C.
W84-04670

Group 2L—Estuaries

THE ESTUARINE CHARACTER OF THE GULF OF NICOYA, AN EMBAYMENT ON THE PACIFIC COAST OF CENTRAL AMERICA,
Woods Hole Oceanographic Institution, MA.
A. D. Voorhis, C. E. Epifanio, D. Maurer, A. I. Dittel, and J. A. Vargas.
Hydrobiologia, Vol. 99, No. 3, p 225-237, March, 1983. 11 Fig, 2 Tab, 10 Ref.

Descriptors: *Estuaries, *Gulf of Nicoya, *Pacific Coast, *Central America, Costa Rica, Temperature, Salinity, Tidal hydraulics, Tides, Mixing, Hydrography.

Hydrography and exchange processes in a tropical estuary, the Gulf of Nicoya, Costa Rica, are described from data collected in 1979 and 1980. The measurements and analyses were made in both the dry season and wet season and include temperature, salinity, and density at twenty locations in the gulf and currents (over a semi-diurnal tidal cycle) at five locations. These new results enlarge on the early study by Peterson. Circulation in the lower gulf shows a marked east-west asymmetry due to the predominant runoff along its eastern shore from Rio Barranca and Tarcoles. The freshened surface water from the upper gulf combines with the runoff from these rivers and flows southward along the eastern side of the lower gulf. This flow is compensated by a northward flow of more saline water on the western side at all depths and on the eastern side along the bottom. The boundary between the southward and northward surface flow is marked by a strong salinity front in the rainy season. There is a rapid increase in tidal energy density toward the shoaling northern reaches of the lower gulf, between San Lucas Island and Puntarenas Peninsula. Enhanced mixing must accompany this increase, and direct measurements in the constriction between San Lucas and Puntaneras show that tidal mixing is dominant in transporting salt into the upper gulf against the freshwater runoff. (Author's abstract)
W84-04683

SEASONAL CHANGES IN NUTRIENTS AND DISSOLVED OXYGEN IN THE GULF OF NICOYA, A TROPICAL ESTUARY ON THE PACIFIC COAST OF CENTRAL AMERICA,
Delaware Univ., Lewes. Coll. of Marine Studies.
C. E. Epifanio, D. Maurer, and A. I. Dittel.
Hydrobiologia, Vol. 101, No. 3, p 231-238, May, 1983. 3 Fig, 4 Tab, 24 Ref.

Descriptors: *Seasonal variation, *Nutrients, *Dissolved oxygen, *Gulf of Nicoya, *Tropical regions, *Estuaries, *Central America, Ammonium, Nitrite, Nitrate, Inorganic phosphate, Chemical properties, Water circulation.

Concentrations of ammonium, nitrite, nitrate, inorganic phosphate, and dissolved oxygen were measured at 15 stations in the Gulf of Nicoya during rainy and dry seasons. Results allowed division of the gulf into three areas. The upper gulf is an area greatly affected by changes in rainfall as levels of nutrients varied by an order of magnitude seasonally. The lower gulf shows less seasonal variation and is characterized by low concentrations of nutrients and high concentrations of oxygen at the surface and high concentrations of nutrients and low concentrations of oxygen at the bottom. Nutrient-rich bottom water in the lower gulf appears to be entrained from offshore by the positive estuarine character of the gulf. This process is facilitated by the extremely narrow shelf along the Pacific coast of Costa Rica. These oceanic waters are mixed vertically in the mid-gulf region and carried into the upper gulf by estuarine circulation. (Author's abstract)
W84-04714

HYDRAULIC FACTORS AND PHYTOPLANKTON IN THE BAIE DE MORLAIX (WESTERN ENGLISH CHANNEL) (FACTEURS HYDROLOGIQUES ET PHYTOPLANCTON EN BAIE DE MORLAIX (MANCHE OCCIDENTALE),
Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
V. Martin-Jezequel.
Hydrobiologia, Vol. 102, No. 2, p 131-143, June, 1983. 11 Fig, 1 Tab, 58 Ref.

Descriptors: *Hydrology, Phytoplankton, *English Channel, Physical properties, Chemical properties, Biological properties, Cycling nutrients, Seawater.

Phytoplankton in Roscoff waters (Western English Channel) was studied in spring and summer of 1979 and 1980, parallel to seasonal changes in physical, chemical and biological variables. Strong tides prevent the formation of a seasonal thermocline and the water column remains well mixed throughout the year. Seasonal changes in temperature and salinity show a continuous increase from April to August-September. Dissolved oxygen, dissolved mineral and organic nitrogen and phosphorus vary in relation to phytoplankton production. Silicate shows a seasonal cycle, but is not completely depleted in the sea-water. A decrease of ammonia during the phytoplankton blooms in 1980 suggests that ammonia plays an important role as a nitrogen source. The NO3/PO4 ratio indicates that the sea-water is heavily loaded with nitrate, and shows peak values during phytoplankton blooms, due to a fall in the concentration of phosphate, which may become a limiting nutrient. However, this effect may be offset by a rapid recycling of this nutrient. Chlorophyll a and potential primary production show significant variations. The major blooms are observed in June during both years. The mean production/chl. a ratio is around 6 in both years. Phytoplankton development is marked by the succession of three major groups, during the spring-summer blooms: Thalassiosira spp, Rhizosolenia spp and Chaetoceros spp. The regularity in phytoplankton species succession over a number of years suggest that the species concerned are autochtonous and well adapted to their environment. (Author's abstract)
W84-04721

THE ROLE OF TIDES IN REMOVING PHOSPHORUS FROM LAKE NAKANOUMI, A COASTAL LAGOON IN JAPAN,
Tokyo Univ. (Japan). Biochemical Engineering Lab.
H. Ohtake, S. Kato, and Y. Date.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 443-462, 1984. 11 Fig, 7 Tab, 9 Ref.

Descriptors: *Lake Nakanoumi, *Japan, *Lagoons, *Tidal effects, *Phosphorus, Land reclamation, Brackish water, Sediments.

Lake Nakanoumi is a shallow coastal lagoon which is connected to the Japan Sea only by a narrow channel. Over the past decade the Nakanoumi Land Reclamation and Freshening Project has been in progress to reclaim a total of 28 sq km of agricultural lands and to convert the remaining water basin into a freshwater basin by damming the narrow entrance. Without a detailed knowledge of the tidal phenomena, it appears unwise to cut off the lagoon from the open sea. The role of tides in removing phosphorus from Lake Nakanoumi was investigated. Measurements of inflow and outflow of phosphorus were made at the Nakaura sluice-gate across the entrance channel during the warmer months from April to November in 1981. The net export of phosphorus from Lake Nakanoumi was about 116 tons (14.5 tons/month). Of this, about 40-60% was flushed away by tidal currents. The phosphorus budget showed that the tidal flushing precluded the accumulation of phosphorus due to release from bottom sediment during the warmer months. Tidal flushing is an important pollutant-removal mechanism in this shallow brackish water environment. (Moore-IVI)
W84-04753

WATER UPTAKE BY ROOTS CONTROLS WATER TABLE MOVEMENT AND SEDIMENT OXIDATION IN SHORT SPARTINA MARSH,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
J. W. H. Dacey, and B. L. Howes.
Science, Vol. 224, No. 4648, 4 May, 1983. 2 Fig, 18 Ref.

Descriptors: *Water uptake, *Plants, *Water table, *Marshes, *Spartina, Oxidation, Sediments, Sediment oxidation, Roots, Grasses, Marsh grass, Nutrients.

Downward movement of the water table during both day and night in the short grass zone of intertidal salt marshes is due not to drainage but to water uptake by roots. Removal of water from the sediment resulted in the entry of air into the sediment, suggesting a feedback between plant growth, water uptake, and sediment oxidation. The water balance of Spartina alterniflora appears to influence the internal morphology of its roots, potentially giving rise to a new mechanism for the mass flow of gas in plants. Aside from the physiological aspects of this study, the observations have profound implications for the interpretation of the biogeochemistry of short S. alterniflora marshes and probably tidal marshes in general. For example, it has long been held that marshes import nutrients and export organic matter to the estuaries and ocean. However, most of the productivity of this ecosystem goes into below ground biomass, which can only be exported in dissolved form, either as dissolved organic carbon or reduced sulfur compounds. The observation of negligible pore-water drainage in the short Spartina zone implies that very little export of dissolved compounds is possible from this part of the marsh. (Baker-IVI)
W84-04767

ARTIFICIAL DIFFUSION IN THE NUMERICAL MODELLING OF THE ADVECTIVE TRANSPORT OF SALINITY,
Institute of Oceanographic Sciences, Birkenhead (England).
A. Owen.
Applied Mathematical Modelling, Vol. 8, No. 2, p 116-120, April, 1984. 8 Fig, 10 Ref.

Descriptors: *Salinity, *Estuaries, *Coastal waters, Mathematical models, Diffusion, Advection, Upstream, Forward time centered space.

The numerical modelling of the transport of salinity in coastal and estuarine regions using upstream finite differences, is considered. Salinity distribution is determined by two distinct physical processes, advection and diffusion. Diffusion is independent of the direction of the fluid flow and can be accurately represented using centered differences. Advection is dependent on the direction of the fluid flow and can be represented using either upstream (US) differences or forward time centered space (FTCS) differences. The artificial diffusion associated with US differences can be incorporated into the physical diffusion in a simple quantitative manner. US differences have the advantage of being transportive, which ensures that they preserve positive definite quantities such as salinity. FTCS differences are not transportive and can give rise to negative salinities and boundary problems. The method presented is always applicable when the artificial diffusion is less than that required physically. Even when this criterion is not satisfied, the US method (with no physical diffusive term) may be preferable to the FTCS method. The method is applicable to finite-difference grids of less than about 2-4 km in tidal problems. For non-tidal problems the method is applicable to larger grids. (Moore-IVI)
W84-04769

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

ARAB POTASH SOLAR EVAPORATION SYSTEM: DESIGN AND DEVELOPMENT OF A NOVEL MEMBRANE CUT-OFF WALL,
G. J. Brice, and J. C. Woodward.
Proceedings of the Institution of Civil Engineers, Vol. 76, p 185-205, February, 1984. 17 Fig, 4 Tab, 4 Ref.

Descriptors: *Potash solar evaporation, *Design criteria, *Membranes, Seepage control, Seepage loss, Seepage, Brines, Permeability, Jordan.

Seepage control was required under a 15 km length of the dikes which form the solar evaporation pans for the Arab Potash project in Jordan. Alternative means of seepage control through the previous rock salt foundations were studied and a novel solution using a membrane cut-off wall was developed. The cut-off involved a 7 m deep excavation of a narrow trench by chain cutter, the development of a self-setting mud which would perform in the very saline conditions, and the use of a semi-rigid polyethylene membrane. This Paper describes the design and development of the membrane cut-off wall, including details of the site conditions, laboratory testing and site trials. (Author's abstract)
W84-04202

SURGE PROTECTION OF WATER SUPPLY PIPELINES FOR JUBAIL INDUSTRIAL CITY,
For primary bibliographic entry see Field 8A.
W84-04204

AGRICULTURAL WASTE WATER - REVERSE OSMOSIS PRETREATMENT,
California State Dept. of Water Resources, Firebaugh.
For primary bibliographic entry see Field 3C.
W84-04232

MASS TRANSFER AND THERMODYNAMIC STUDIES OF EVAPORATIVE FREEZING OF WATER,
Delaware Univ., Newark. Dept. of Chemical Engineering.
L. Pigford.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153501, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, June, 1983. 17 p, 16 Fig, 1 Tab, 4 Ref. Project No. OWRT C-80280-S (8527) (1), Contract/Grant No. 14-34-001-8527.

Descriptors: *Mass transfer, AFVC process, absorption, Salt water, *Thermodynamic properties, *Freezing, Evaporative freezing, Water treatment, Vapor compression, Solvents.

Some of the key technical problems inherent in the design of equipment for the absorption, freezing, vapor-compression process for the production of pure water from salt water were investigated in laboratory studies. These included the comparison of various solvents for water vapor in the freezer-absorber unit, the determination of water mass transfer rates into concentrated salt solution in the refrigerated absorber, and the measurement of mass transfer coefficients for the absorption of water into a solvent stream that flows over horizontal tubes. The results showed that changes of the solvent can have only a small effect on the power required, that the resistance to heat transfer in the absorber has a greater effect than the resistance to mass transfer. Accumulation of air in the absorber vapor can be important.
W84-04235

APPLIED SIMILARITY CRITERIA IN THE SCALE-UP FROM EXISTING TO LARGE MSF DESALINATION PLANTS,
Aquila Univ. (Italy). Facolta di Ingegneria.
D. Barba, S. Arazzini, and G. Migliorini.
Desalination, Vol. 49, No. 1, p 1-15, January, 1984. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination plants, Comparison studies, Desalination, Economic evaluation, Performance evaluation, Scale-up desalination plants, Evaporator parameters, Brine flow rate, Flashdown, Froude, Dimensionless vapor velocity.

The trend of building large desalination water stations with a large number of parallel units of 5-6 migd each is critically examined. The opportunity to increase unit size to 12-13 migd for cross tube and to 20-25 migd for long tube geometry has been discussed previously. In this paper optimal sizes analyzed for cross tube and for long tube geometry are 12 migd and 18 migd respectively, and the similarity criteria, that can be used for design purposes starting from the behavior of two reference industrial plants (5 migd cross tube and 8 migd long tube respectively), are illustrated. The scale-up from existing units is based on the similarity of evaporator parameters: brine specific flow rate, flashdown, Froude number at entrance of the stages, dimensionless vapor velocity at the brine release surface, dimensionless vapor velocity through the demisters, two phases flow parameters at the cross-section below the distillate channel (only for cross tube geometry), dimensionless stage length defined as the ratio between actual and critical length. The designs of new large units, characterized by process and geometrical features similar to the reference plants based on these profiles, allows the same water purity and performance ratio for the new capacities. An economic analysis on a standard 6 migd unit shows that the investment cost/cu m/d is about 20% lower for 12 migd cross tube and 30% lower for 18 migd long tube plants. (Author's abstract)
W84-04553

ENERGY SAVINGS IN DISTILLATION PLANTS BY USING VAPOR THERMO-COMPRESSION,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Dept. of Mechanical Engineering.
S. E. Aly.
Desalination, Vol. 49, No. 1, p 37-56, January, 1984. 5 Fig, 13 Ref.

Descriptors: *Distillation plants, *Vapor thermocompression, Desalination, Distillation, Performance evaluation, Thermodynamic analysis, Heat exchangers, Desalination plants.

A suggestion for more efficient utilization of the available energy in single purpose distillation desalination units is presented. It includes the introduction of a vapor thermo-compression multi-effect unit to replace the pressure reducing valves and/or the superheaters usually used at the brine heaters. Furthermore, using the VTC/VTE configurations would allow raising the top effect temperature up to 136 C. The combined system including the VTC/VTE is analyzed and some practical cases are investigated. Thermodynamic analysis showed an increase in the fresh water production by up to 100% with extra heat input of only about 19% of the original plant heat requirements. In the analysis, subatmospheric effects were not used in order to avoid the interference between the jet booster of the vapor compression and the steam jet ejector required to evacuate the non-condensable gases. A flow sheet for the combined system is presented and the operating flexibility is pointed out. Such a system can operate efficiently with favorable response to heat input and demand changes. (Author's abstract)
W84-04554

AN EXPERIMENTAL STUDY OF THE COMPLETE-MIXING MODEL FOR RADIAL FLOW HOLLOW FIBER REVERSE OSMOSIS SYSTEMS,
State Univ. of New York at Buffalo, Amherst. Dept. of Chemical Engineering.
M. Soltanieh, and W. N. Gill.
Desalination, Vol. 49, No. 1, p 57-88, January, 1984. 18 Fig, 3 Tab, 29 Ref. NIH grant BRSGS07-RR-07066-18.

Descriptors: *Complete-mixing model, *Radial flow, *Hollow Fibers, *Reverse osmosis, Permeability coefficient, Desalination, Model studies, Mathematical equations.

The complete mixing model of hollow fiber systems predicts that 1/average R is linear in Sm/Fp, regardless of the membrane transport model which is included in it, and this is confirmed experimentally for the units studied here. The plug flow model, which has been used by all previous investigators, fails to predict this observed fact. It is shown experimentally, by using two radial flow hollow fiber modules of different lengths, that the linear relationship between 1/average R and Sm/Fp exists at all levels of concentration (from 1000 to 35,000 ppm), pressure (from 150 to 400 psi), and feed flow rate (from 75 cu cm/s to 400 cu cm/s). Furthermore, at higher concentrations, plots of 1/average R vs Sm/Fp become independent of concentration and are represented by a single line. The pure water permeability coefficient (A) at 25 C ranges from 7.393 x 10 to the minus 12th power to 9.277 x 10 to the minus 12th power sq cm/s/g for the large module, and from 4.764 x 10 to the minus 12th power to 4.950 x 10 to the minus 12th power sq cm/s/g for the small module when pressure decreases from 400 to 200 psi. Futhermore, A is not a strong function of pressure; it decreases by about 20% for the large module (the more permeable membrane) and about 4% for the small module, when pressure increases by a factor of two. The solute permeability coefficient (K2) determined by two methods is relatively constant with pressure and is a function of concentration only up to a certain level, after which it remains constant. Based on the complete-mixing model, K2 for the large module remains constant at about 1.48 x 10 to the minus 5th power cm/s above a concentration of about 10,000 ppm and for the smaller module (with less permeable membrane) K2 becomes constant at about 0.216 x 10 to the minus 5 cm/s above a concentration of about 5000 ppm. The solute permeabilities calculated from the complete-mixing model are 10 to 25% lower, but show the same trend with concentration as those obtained by using the plug flow approach. (Author's abstract)
W84-04555

APPROPRIATE MINERAL CONTENT OF DESALINATION WATER - THEORY AND DRINKERS' REACTION. PART I,
Italimpianti of Australia Pty Ltd., Sydney.
E. Gabrielli, and J. P. Gerofi.
Desalination, Vol. 49 No. 1, p 95-103, January, 1984. 2 Tab, 20 Ref.

Descriptors: *Desalination, *Drinking water, *Minerals, Sodium, Calcium, Chloride, Metals, Total dissolved solids, Water treatment, Taste.

Reasons for adding inorganic substances to the raw water product from a desalination plant include: making the water more palatable, making the water less aggressive to metal pipes, and to ensure that the resulting water does not cause known health effects. The optimal content of the major ions affecting the quality of drinking water produced by desalination and the remineralization processes by which the various blends can be attained are discussed. Practical criteria indicate that in most cases the total dissolved solids should be in the range of 200-400 mg/l with a content of chloride and sodium ion less than 150 mg/l and 100 mg/l, respectively, and of calcium ion in the range 50-75 mg/l. Hardness should be in the range of 8-20 French degrees, with magnesium and iron less than 10 mg/l and 0.05 mg/l respectively. The concentration of sulfate ion can be anywhere up to a maximum of 200 mg/l. Carbonate ion should be less than 35 mg/l. (Baker-IVI)
W84-04557

3B. Water Yield Improvement

THE NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION PROJECT,
Industrial Sites and Water Resources Development Corp., Seoul (Korea).
For primary bibliographic entry see Field 6G.
W84-04504

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - ECOLOGICAL ASPECTS,
Euroconsult, Arnhem (Netherlands).
For primary bibliographic entry see Field 6G.
W84-04505

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - MORPHOLOGICAL ASPECTS,
Waterloopkundig Lab., Delft (Netherlands).

For primary bibliographic entry see Field 6G.
W84-04506

WATER QUALITY ASPECTS OF THE NAK-DONG ESTUARY BARRAGE,
DHV Consulting Engineers, Amersfoort (Netherlands).
For primary bibliographic entry see Field 6G.
W84-04507

3C. Use Of Water Of Impaired Quality

AGRICULTURAL WASTE WATER - REVERSE OSMOSIS PRETREATMENT,
California State Dept. of Water Resources, Firebaugh.
C. Hild, R. Lindholm, D. Brice, and G. Klein.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153543, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, June, 1983. 71 p, 12 Fig, 12 Tab, 3 Append. Project No. OWRT C-00211-R (0529) (1), Contract/Grant No. 14-34-0001-0529 (1).

Descriptors: *Reverse osmosis, Desalting, *Ion exchange, *Water softening, Brackish water, Regeneration, Expanded bed, Brine, Recirculation, Automation, *Desalination, Agricultural wastewater, Pretreatment, Pilot plants, Wastewater treatment.

Investigations were made to demonstrate that an ion-exchange (IX) softening system regenerated with reverse-osmosis (RO) reject brine can be operated successfully on a sustained basis to provide softened feed water for an RO system used to desalt brackish water. Various combinations of operating conditions were evaluated to determine sustainable conditions that would produce the largest quantity of softened water per unit of regenerant used. During the investigations, two transparent plastic IX columns were operated alternately in softening and regeneration modes. The resin bed, which was three feet deep during the down flow softening mode, was expanded by 50 and 100 percent of its height during the upflow regeneration mode. RO brine and recirculated regenerant were used to regenerate the IX system. A computer program was used to assess the degree of supersaturation of the regenerant in its course through the IX columns. The IX-RO system was operated in an automated mode to demonstrate that the system could be operated without frequent attention. It was concluded from this study that an IX system regenerated with RO reject Brine can be operated successfully to provide softened feed water for the RO system. The pilot plant operating under optimum conditions produced 1.4 gallons of softened water per gallon of regenerant used. The IX-RO system can be automated.
W84-04232

RENOVATION OF STEAM ELECTRIC POWER PLANT COOLING TOWER BLOWDOWN FOR NON-POTABLE REUSE,
Rexnord, Inc., Milwaukee, WI. EnviroEnergy Technology Center.
For primary bibliographic entry see Field 5F.
W84-04237

DEVELOPMENT AND APPLICATION OF MODELS FOR PLANNING OPTIMAL WATER REUSE,
Texas Univ. at Austin. Center for Research in Water Resources.
L. W. Mays, G. Ocanas, and M. Schwartz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153527, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-82/14, U.S. Bureau of Reclamation, Washington, DC., July, 1983. 175 p, 40 Fig, 22 Tab, 68 Ref. Project No. OWRT C-90095-R(9438)(2), Contract/Grant No. 14-34-0001-9438.

Descriptors: *Water reuse, *Optimization, Water supply, *Water quality, *Regional planning, Wastewater treatment, *Optimal development plans, *Optimization models, Software development, Nonlinear programming, Dynamic programming, Reduced gradient methods, Capacity expansion.

Water reuse planning models have been developed for determining the optimum allocation of water and reuse of wastewater on a regional basis for single and multiperiod planning that minimizes the overall cost of water supply. Both water quantity and water quality parameters of various sources of flows can be considered. Wastewater for all use sectors, along with freshwater, can be considered as candidate source or origins of water. The models consider the capacity expansion of treatment facilities and allow for economies of scale in treatment and transportation through the use of nonlinear objective functions. Two basic types of optimization models were developed in this research. The first type are single and multi-period models considered as 'macro-level' models which consider regional planning aspects for relatively large planning periods. These mathematical models are large-scale nonlinear programming (LSNLP) models. The second basic type of models are dynamic programming (DP) models for the detailed optimal selection of treatment alternative (processes). In comparison to the LSNLP modes, these DP models (allocation DP and treatment DP) models consider only a portion of the regional system over a planning horizon with several smaller small time increments.
W84-04240

LYSIMETER STUDIES TO MEASURE WASTEWATER PURIFICATION LEVEL AND NUTRIENT CONCENTRATION IN PERCOLATED WATER (LYSIMETERUNTERSUCHUNGEN ZUR ABWASSERREINIGUNG UND NAHRSTOFFKONZENTRATION IM SICKERWASSER),
Forschungszentrum fuer Bodenfruchtbarkeit Muencheberg(German, D.R.).
L. Forster, O. Muller, and K. Schwarz.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 138-140, April, 1983. 3 Tab, 10 Ref.

Descriptors: *Wastewater irrigation, *Percolating water, *Wastewater treatment, Land disposal, Nutrient removal, Grass, Crop yield, Nitrogen, Phosphorus, Potassium, Groundwater pollution.

Lysimeter studies were conducted on percolated water under two types of soil (clayey, C, and sandy, S) used in the cultivation of grass (for hay and animal feed) and irrigated with partially purified wastewater. Grass yield in dry volume from C was 154.5, 156.7, and 152.7 dt/ha for 240, 360, and 480 mm wastewater applied, respectively. For S, grass yields were 140.4, 127.8, and 114.1 dt/ha for 360, 480, and 720 mm wastewater, respectively. From an agricultural point of view only a limited amount of wastewater could be applied productively (yield-oriented irrigation). When evaporated water was replaced by a 15% wastewater supplement on C together with mineral fertilization to replace elements removed from the wastewater by preliminary mechanical treatment, a significant crop yield increase occurred (183.2 dt/ha for 490 mm wastewater). This procedure is however not possible in practice. S produced an 11.4-16.3% lower grass yield than C when the same amounts of wastewater were applied. The level of purification achieved, as measured by nitrogen, phosphorus, and potassium concentrations as well as 5-day BOD in percolated water, was markedly better than that of artificial biological wastewater treatment. Used in an appropriate way, agricultural wastewater utilization could achieve purification levels similar to those of third-stage treatment. German Democratic Republic standards for drinking water were violated by phosphorus levels in percolated water under both C and S, by potassium levels under S, and occasionally by NO3-N levels. No violations were found for calcium, magnesium, sodium, or chlorine. (Gish-IVI)
W84-04792

3D. Conservation In Domestic and Municipal Use

ELASTICITY OF DEMAND FOR RESIDENTIAL WATER: POLICY IMPLICATIONS FOR SOUTHERN ARIZONA,
Arizona Univ., Tucson. Coll. of Business and Public Administration.
R. B. Billings, and W. M. Day.
Arizona Review, Vol. 31, No. 2, p 1-11, 1983. 5 Fig, 1 Tab.

Descriptors: *Water conservation, *Pricing, *Water demand, *Arizona, Tucson, Water use, Public policy, Decision making, Planning.

A comprehensive analysis was undertaken in southern Arizona of the response of residential water use to pricing, economic, demographic and weather variables. Findings which are important for water policy decision making are reported. The major trend observed was decreased average residential water use. Average use declined by about 38% from 1974 to 1980, a period in which real inflation-adjusted costs of water and sewer services increased 52%. During the past 9 years residential customers in Tucson reduced their water use by about 7% for each 10% increase in the real (inflation-adjusted) average price of the water. For each 10% increase in the index of water publicity, water use fell by about 1% during the crisis period, but by slightly less than half this amount during normal times. Given that price increases do promote water conservation, a difficult issue facing policy makers is the justification of a price in excess of that required to cover utility operating costs in order to force additional conservation. (Baker-IVI)
W84-04388

WATER CONSERVATION: THE STRUGGLE OVER DEFINITION,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
D. D. Baumann, J. J. Boland, and J. H. Sims.
Water Resources Research, Vol. 20, No. 4, p 428-434, April, 1984. 3 Tab, 27 Ref. Army Corps of Engineers, Institute for Water Resources contract DACW72-78-C-0022.

Descriptors: *Water conservation, *Definition, Water management, Metropolitan water management, Water supply, Optimization.

During the 1970's much attention was focused on the role of water conservation in the planning and management of urban water supplies, and actions to implement water conservation were taken at all levels of government. Yet many policies and programs appear to rely on conceptions of water conservation which confuse supply and demand oriented strategies or which inefficiently conserve water at the expense of other scarce resources. Through an analysis of the underlying concepts and values, a definition of water conservation is reached which is both precise and practical and which provides a sound basis for the development of water conservation policies. Examples drawn from recent field studies illustrate the application of the definition. (Author's abstract)
W84-04566

3E. Conservation In Industry

WATER RECYCLE IN THE ORGANIC CHEMICAL AND PLASTIC MATERIALS INDUSTRIES,
Centec Corp., Reston, VA.
P. Crampton, A. Procko, D. Sherman, and J. Boutross.
Available from the National Technical Information Services, Springfield, VA 22161 as PB84169416, Price codes: A09 in paper copy, A01 in microfiche. Report OWRT/RU-82/18, Bureau of Reclamation, Washington, D.C., July, 1983. 164 p, 25 Fig, 26 Tab, 10 Ref, 2 Append. Projects No. 90181-R (04 OWRT 73) (1), Contract No. 14-3400001-0473.

Descriptors: *Alternative water use, *Industrial water use, *Industrial cooling water, *Wastewater treatment, *Water reuse, *Water softening, *Advanced wastewater treatment, Chemical industry, Chemical wastes, Coagulation, Groundwater availability, Municipal wastewater, Chemical sludge, Sludge disposal.

Findings are presented of a study to assess the potential for fresh water withdrawals in the Organic Chemical and Plastic Materials industry by internal recycle of water or the use of reclaimed municipal effluent. Broadly applicable water recycle options were evaluated in terms of the impact of total water withdrawal for individual facilities, specific products, individual water resource region, and the industry as a whole. The report concludes that currently available technology, if broadly applied, has the potential to significantly reduce water withdrawals by the industry. The recycle options evaluated have proved successful in the limited applications implemented at this time. Recommendations for future activity to foster implementation of water recycle options are also presented.
W84-04406

RESULTS AND GOALS OF THE SAALE-WERRA WATER MANAGEMENT AREA IN RATIONAL WATER USE (ERGEBNISSE UND AUFGABEN DER WASSERWIRTSCHAFTS-DIREKTION SAALE-WERRA BEI DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
G. Franke.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 89-90, March, 1983.

Descriptors: *Water management, *Water conservation, *East Germany, Water use, Industrial water, Water demand, Wastewater treatment.

Efforts of the Saale-Werra Water Management Area (German Democratic Republic) to realize the goals set for the water industry by the 1983 Economic Plan are described. Unfavorable hydrologic conditions exist, but the 'Directive for Rational Water Use in the Five-Year Plan 1981/85' provides guidelines, and the 1982 water law provides the means for implementation. The Saale-Werra Area (29,000 sq km) covers 27% of the GDR and contains 35% (5.9 million) of its population. It has 78,000 water users, whose 3.7 billion cu m/yr (3 million from surface water) demand can be covered in a stable fashion by its 104 reservoirs (450 million cu m capacity) and the multipurpose Saale Valley dam facility. The 10 biggest users require 52% of the total industrial water demand. Institution of rational water use resulted in a 0.2% increase in water use from 1980 to 1981, well under the 1% increase allowed by the 'Directive.' The goal of cutting specific water demand by 5% was not met (a reduction of 4.2% was achieved) because an unavoidable increase in demand occurred in the Leipzig and Suhl districts. Goals for rational water use in 1983 include reductions in use losses upstream of the standard user to ensure a full supply to the standard user, efforts on the part of the main user to decrease demand, and the addition of small streams needed for agriculture to the main work when the supply to industry is failing. Wastewater treatment must be improved by reclaiming valuable chemicals and minerals, by start-up of the first level of biological treatment at the Espenhain brown coal refinery and of a salt-diversion facility at another plant, continuation of biological treatment at the Buna chemical works and of the Leipzig-Rosental municipal wastewater treatment plant. (Gish-IVI)
W84-04779

3F. Conservation In Agriculture

ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION ON THE HIGH PLAINS IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 4B.
W84-04257

WATER-USE EFFICIENCY IN CROP PRODUCTION,
Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W84-04284

AGRICULTURAL DEMAND FOR WATER IN LOWLAND AREAS,
D. Evans.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 513-521, December, 1980. 6 Fig, 6 Ref.

Descriptors: *Water demand, *Water resources development, *Agriculture, *England, Irrigation, Sub-irrigation, Spray irrigation, Crop yield, Water supply.

In 1980 the Government's Advisory Council for Agriculture and Horticulture (ACAH) produced a report on the future needs of water for agriculture in the lowland areas of England. Water for livestock was identified as the largest component of agricultural demand. Water for crops is dealt with, including both spray irrigation and sub-irrigation plans as well as crops which are grown in water. ACAH has predicted a four-fold increase in irrigation needs, but it is uncertain if this figure will become fact. A policy decision has been made by the Anglian Water Authority to make raw water available where it is economic to do so, in national terms, and to develop a method of cost-benefit appraisal of relevant schemes. (Baker-IVI)
W84-04314

OPTIMUM WATER USE BY STONE FRUIT THROUGH IRRIGATION SCHEDULING,
Michigan State Univ., East Lansing. Dept. of Horticulture.
For primary bibliographic entry see Field 2I.
W84-04408

NITROGEN AND YIELD AS RELATED TO WATER USE OF SPRING BARLEY,
New Mexico State Univ., Las Cruces. Dept. of Agricultural Engineering.
C. E. Kallsen, T. W. Sammis, and E. J. Gregory.
Agronomy Journal, Vol. 76, No. 1, p 59-64, January-February, 1984. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Evaporation, *Crop yield, Barley, Evapotranspiration, Transpiration, Nitrogen, Water use, Efficiency.

The water production function is the relationship between marketable crop yield and seasonal evapotranspiration. Variability in the parameters of the function for different growing seasons results in error in estimating the effect of a water management strategy on yield. Experiments were conducted to determine if the parameters describing the functional relationship between transpiration and yield for field grown spring barley was stable for different levels of nitrogen fertility and seasonal differences in the atmospheric evaporative demand. N fertility did not affect water use efficiency (WUE) when efficiency is expressed as the weight of grain yield produced per depth of water transpired. The level of N fertility may affect the WUE when the WUE is expressed as the weight of grain yield produced per depth of water evapotranspired, as a result of differences in the evaporation component associated with the interaction of the irrigation frequency with the degree of ground cover achieved by the crop. (Baker-IVI)
W84-04417

SIZE DISTRIBUTION OF THE ON-FARM IRRIGATION PUMPING PLANTS IN THE U.S.,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. R. Gilley, D. L. Martin, and R. N. Clark.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 406-411, March-April, 1983. 6 Fig, 4 Tab, 3 Ref.

Descriptors: *Irrigation, *Pumping plants, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, Texas, United States.

Over 473,000 on-farm pumping plants were used to pump and deliver irrigation water in the United States in 1979. Over 60% of these units were smaller than 37.3 kW (100 hr). Two steps were necessary to estimate the number of pumping plants in the different size categories using groundwater sources. First, the distribution of the various pump sizes required for the different irrigations was determined and second the total number of units used for a particular irrigation system was estimated. The distribution of the pumping plant sizes for the various irrigation systems was determined using the system flow rate and pumping lift data. Nearly one-half of the pumping plants (231,440) were located in the six High Plains States of Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Texas. (Baker-IVI)
W84-04423

EVALUATION OF A WATER MANAGEMENT MODEL FOR IRRIGATED AGRICULTURE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
A. C. Chang, R. W. Skaggs, L. F. Hermsmeier, and W. R. Johnston.
Transaction of the American Society of Agricultural Engineers, Vol. 2, No. 2, p 412-422, March-April, 1983. 4 Ref 6 Tab, 27 Ref.

Descriptors: *Model studies, *Irrigation, *Water management, DRAINMOD, Computers, Seepage, Water table, Evaluation, Management.

DRAINMOD is a computer model simulating the movement and storage of water in soils with a shallow water table in the humid region. The model was developed for the comprehensive analysis of soil water transformation on a field scale where most water management facilities are designed and installed as a single unit. DRAINMOD was used to simulate the water balance in an irrigated cropland. Water table elevations predicted by DRAINMOD agreed reasonably well with measurements for 5 experimental locations differing in soil texture in the San Joaquin Valley and the Imperial Valley of California. Water loss by deep seepage is a significant component in soil water balance for irrigated crop land tested. When the water table drawdown exceeded 150 cm, the model tended to overestimate the depth of water table. (Baker-IVI)
W84-04424

FIELD QUANTIFICATION OF CROP WATER STRESS,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W84-04440

LEPA IRRIGATION SYSTEM EVALUATION,
Texas Agricultural Experiment Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 776-781, May-June, 1983. 1 Fig, 7 Tab, 4 Ref.

Descriptors: *Low energy precision application, *Irrigation efficiency, Sprinkler irrigation, Furrow irrigation, Cost analysis, Soybeans, Micro-basin tillage.

The LEPA (Low Energy Precision Application) irrigation system distributes water directly to the furrow at very low pressure through drop tubes and emitters which are located at a height of 5 to 10 cm above the furrow. The system was designed to minimize the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. It was also designed to maximize rainfall utilization by conjunctive use with micro-basin tillage. The LEPA (Low Energy Precision Application) irrigation concept has been extensively tested for two years and compared with sprinkler and furrow methods. The evaluation in-

cluded application efficiency, distribution efficiency, water use efficiency and energy savings potential. The LEPA performance was consistantly high in all areas evaluated and fluctuated over a very narrow range, indicating that the objective was successfully met. Soybeans were used as a test crop and the yield data support the irrigation efficiency results and indicate an economic justification for conversions to LEPA irrigation. (Moore-IVI)
W84-04441

OPTIMIZING FURROW IRRIGATION RUNOFF RECOVERY SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Chemical Engineering.
J. M. Reddy, and W. Clyma.
Transactions of the American Society of Agricultural Engineers, Vol. 25, No. 4, p 1050-1056 and 1063, July-August, 1983. 1 Fig, 4 Tab, 23 Ref. USAID contract AID/DSAN-C-0058.

Descriptors: *Furrow irrigation, *Irrigation design, *Runoff recovery, Optimization, Cost analysis, Geometric programming.

Design parameters of a furrow irrigation runoff recovery system were optimized using the generalized geometric programming technique. The cost of pumping water from the well and the sump, the cost of labor, and the cost of constructing the sump were considered in the objective function. The major constraints specified were on the requirement depth and the volume of runoff at the end of irrigation (specified to be zero). A sample problem was solved using the geometric programming technique. The cost of system design using the present technique ($184/ha) was significantly cheaper than the trial and error solution ($275/ha). This increase in the cost of system design was mainly due to the difference in the volume of runoff collected in the sump. The trial and error solutions are tedious and constraints cannot be directly included in the design process. Conversely, the system constraints and cost coefficients can be directly incorporated into the optimization technique. Irrigation runoff recovery systems can be designed effectively for minimum cost using the optimization technique. (Moore-IVI)
W84-04447

DESIGN OF GRASS-LINED OPEN CHANNELS,
Agricultural Research Service, Stillwater, OK. Crop Production and Water Conservation Lab.
D. M. Temple.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1064-1069, July-August, 1983. 2 Tab, 9 Ref, 3 Append.

Descriptors: *Tractive forces, *Grassed waterways, *Open channels, *Design, Mathematical models, Linings, Soil conservation, Sediment transport, Stability, Vegetation.

Grass linings may provide an attractive alternative to structural stabilization methods for earth channels exposed to flow only intermittently. Recent advances in the understanding of the behavior of flow over vegetation is placed into the format of a numerical design procedure for grass-lined channels. A step by step computational procedure for stability design is presented with example computations and a discussion of the required parameters. The procedure is semiempirical and was formulated using a dominant parameter approach. Thus it cannot replace engineering judgment as an essential part of the design process. In addition to its numerical format, the advantages of the outlined procedure include reduced subjectivity in vegetal retardance estimation and increased flexibility in application. By separating the influence of the vegetal action from soil and geometry consideration, designs may be reasonably modified to reflect local conditions. (Baker-IVI)
W84-04449

SPRAY LOSSES AND PARTITIONING OF WATER UNDER A CENTER PIVOT SPRINKLER SYSTEM,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
J. L. Steiner, E. T. Kanemasu, and R. N. Clark.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1128-1134, July-August, 1983. 4 Fig, 5 Tab, 26 Ref.

Descriptors: *Center pivot irrigation, *Sprinkler irrigation, *Spray losses, Corn, Vapor pressure, Water partitioning, Wind, Air temperature, Canopy, Stemflow, Interception.

Center pivot irrigation is extensive in the Great Plains agricultural regions. The efficiency of a center pivot sprinkler system was analyzed by monitoring spray losses under various climatic conditions and by examining the partitioning of water within a corn (Zea mays L.) canopy. Average spray losses were 12% in 1980 and 16% in 1981. Spray losses were significantly correlated with vapor pressure deficit ($r_{x,y} = 0.49$), temperature ($r_{x,y} = 0.47$) and a wind-vapor pressure deficit term ($r_{x,y} = 0.45$). The unexplained variability in the data may be attributed to the difficulty of determining the exact application rate at a particular area of the field and to the interaction between climatic conditions and wind orientation relative to the sprinkler lateral. Under full canopy condition in corn, about half of the water reaching the soil surface is via stemflow with the remainder falling or dripping through to the soil surface. We found 2.7 mm of canopy storage in a full corn canopy. Net loss of plant intercepted water depends on the temperature and on the ratio of canopy (rc) and aerodynamic (ra) resistances to vapor flux, with net losses being small if rc/ra is low and temperatures are high. (Author's abstract)
W84-04458

UNIFORMITY DESIGN CRITERIA UNDER LIMITED WATER,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
R. D. von Bernuth.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1418-1421, September-October, 1983. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Sprinkler irrigation, *Design criteria, *Available water, *Uniformity, Irrigation water, Mathematical models, Economic aspects.

Traditional uniformity design criteria for set type sprinkler irrigation systems has included a minimum design coefficient of uniformity (CU). When the total water available for irrigation under set type irrigation is limited, the economically optimal design CU becomes a function of the crop response to water. The LaGrangean constrained maximization technique can be used to determine optimal uniformity design criteria. When the amount of irrigation water available is limited, the design coefficient of uniformity will vary with local conditions and prices, and may well be less than traditional values. The statistical moments needed to determine the optimal design CU depend upon the order of the function used to describe production. In theory, no optimal CU exists for the purely linear production function, but in actuality one does exist because there must be some upper limit on production. (Moore-IVI)
W84-04468

INFILTRATION AND SUBSEQUENT EVAPORATION FROM SURFACE-AGGREGATED LAYERED SOIL PROFILES UNDER SIMULATED LABORATORY CONDITIONS,
Ghent Rijksuniversiteit (Belgium). Lab. of Soil Physics, Soil Conditioning and Horticultural Soil Science.
For primary bibliographic entry see Field 2G.
W84-04514

EFFECT OF IRRIGATION ON THE PHYSICAL PROPERTIES OF DARK CHESTNUT SOLONETZIC SOILS, NORTHERN CRIMEA,
P. I. Kukoba, and S. A. Balyuk.
Soviet Soil Science, Vol. 15, No. 2, p 104-110, 1983. 6 Tab, 18 Ref. Translated from Pochvovedeniye, No. 4, p 91-97, 1983.

Descriptors: *Irrigation effects, *Soil properties, *Crimea, *USSR, Solonetzic soils, Soil water, Argillization, Compaction, Porosity, Permeability, Soil physical properties.

Changes made by irrigation practices in the physical properties of dark Chestnut Solonetzic soils in the Bay of Sivash region of the Northern Crimean Irrigated Massif were described. The study of particle size, microaggregate composition, and hydrophysical properties demonstrates that irrigation causes significant, statistically demonstrable changes in the properties of the upper soil horizons. In irrigated soils with normal cultivation there is a tendency for irrigation argillization, an increase in the dispersion of aggregates, and the destruction of soil structure. Bulk density increases in irrigated soils and the total porosity, aeration porosity, and permeability all decrease. Meliorative trench and deep (40 cm) plowing with the application of 5 tons/ha phosphogypsum not only prevent the deterioration of the physical properties of irrigated soils, but also significantly improve them. (Baker-IVI)
W84-04525

EFFECT OF CALCIUM ON WATER-STRESS-INDUCED BIOCHEMICAL CHANGES AND YIELD OF FIELD-GROWN RICE,
Burdwan Univ. (India). Plant Physiology and Biochemistry Lab.
B. Nayek, A. K. Biswas, Jr., and M. A. Choudhuri.
Biologia Plantarum (Praha), Vol. 25, No. 2, p 117-123, 1983. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Water stress, *Calcium, *Rice, Plant water potential, Water content, Proline, Chlorophyll, Crop yield.

Three different treatments by calcium (0.001 M), namely seed treatment, foliar spraying and their combination were applied on field-grown rice (Oryza sativa L. ev. Ratna) under both water stressed and non-stressed conditions in the course of plant development. The relative water content and leaf water potential decreased with increase in age of stressed and non-stressed plants. Pretreatment of seeds with Ca improved the water status of the plants most prominently at the vegetative stage but the effect gradually faded away with plant development. The foliar spraying by Ca was more effective in improving the water status of the plants at the reproductive stage. The combined Ca treatment signficantly improved water status of the plants both at the vegetative and reproductive stages. The contents of chlorophyll and protein decreased and the activities of protease and RNase increased in the course of plant development in both non-stressed and even more in stressed plants. Ca treatments of seeds or plants or their combination inhibited the decline in chlorophyll and protein contents and the rising trends of protease and RNase activities, the combined treatment being most effective. During plant development free proline content increased significantly more in water stressed plants. In non-stressed plants there was a marked increase in the free proline content as the mature fruit stage. Ca treatment inhibited the rise of free proline in stressed plants. A significant reduction in yield components and yield of the crop in water stressed plants was increased by Ca treatment. (Author's abstract)
W84-04773

DIURNAL VARIATION IN LEAF WATER POTENTIAL, STOMATAL CONDUCTANCE, AND IRRADIANCE OF WINTER CROP UNDER DIFFERENT MOISTURE LEVELS,
Haryana Agricultural Univ., Hissar (India). Dept. of Agronomy.
P. Rao, and S. K. Agarwal.
Biologia Plantarum (Praha), Vol. 26, No. 1, p 1-4, 1984. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Irrigation effects, *Plant water potential, *Stomatal conductance, *Irradiance, Diurnal variation, Mustard, Chickpea, Barley, Soil temperature, Leaf temperature, Relfectance.

Mustard (Brassica juncea Coss.), chickpea (Cicer arietinum L.) and barley (Hordeum vulgare L.) were grown under different moisture levels. Diurnal changes in leaf water potential showed lower values and higher fluctuation in mustard, chickpea and barley grown with no irrigation as compared to one supplemental irrigation. Diurnal maximum of adaxial stomatal conductance in mustard and barley was higher under one irrigation treatment. In mustard stomatal conductance of abaxial surface of leaf remained higher than adaxial surface of leaf throughout the day, wherease the reverse was true in barley. Also the leaf and soil temperature and reflectance were slightly higher in all the three crops under no irrigation. (Author's abstract)
W84-04776

RESULTS AND GOALS OF RATIONAL WATER USE AND WATER CONSERVATION IN SOCIALIST AGRICULTURE (ERGEBNISSE UND AUFGABEN BEI DER RATIONELLEN WASSERVERWENDUNG UND DEM SCHUTZ DER GEWASSER IN DER SOZIALISTISCHEN LANDWIRTSCHAFT),
E. Clausnitzer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 111, April, 1983.

Descriptors: *Water conservation, *Water quality control, *East Germany, *Agriculture, Irrigation water, Water demand, Water use, Farm wastes, Groundwater pollution, Water reuse.

The directive on rational water use in the Five-Year Plan 1981/85 of the German Democratic Republic (GDR) sets concrete goals for socialist agriculture, including reducing by 10-15% water used in newly created overhead irrigation areas, minimization of water use and wastewater in the animal products industry, reclamation of valuable substances from wastewater in the food industry, introduction of water-conserving technology and facilities for agricultural cooling and flushing processes, and to institute liquid-manure, silage, dunging, and pest control procedures that will not impair ground water. Significant successes have been achieved with water-conserving drinking devices for animals, stable-cleaning techniques using little water, and impulse and root irrigation procedures. Rational water use saves fuel and allows wastewater recycling, e.g., for farmyard cleaning. In the GDR, 58% of the total drainage and new formation of groundwater comes from agricultural land, making control of liquid manure a necessity. In 1982, in compliance with the new water law, storage capacity for liquid manure was increased by 979,000 cu m, that for dung water by 210,000 cu m, and that for dung by 320,000 sq m. In 1983 and thereafter, agricultural and water-management organizations will work together to plan rational water use and water protection measures. By 1985, 80% of water use in agriculture should conform to standards. (Gish-IVI)
W84-04785

THE CONTRIBUTION OF SOCIALIST AGRICULTURE TO THE IMPLEMENTATION OF THE SPECIFICATIONS OF THE NEW WATER LAW (DER BEITRAG DER SOZIALISTISCHEN LANDWIRTSCHAFT ZUR DURCHSETZUNG DER BESTIMMUNGEN DES NEUEN WASSERGESETZES),
G. Pallmann.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 112-113, April, 1983.

Descriptors: *Water conservation, *Agriculture, *Water pollution control, *East Germany, Water use, Drainage, Irrigation, Farm wastes, Manure, Water management, Fertilizers, Agricultural chemicals, Land use.

The most important contribution of agriculture to the implementation of the German Democratic Republic's water law of 7/2/1982 is effective land use, which is the best guarantee for rational water use and water conservation. In 1983, facilities to increase the present 1,605 million hectares (ha) of drained land by 65,000 ha will be constructed. Up to 40 million cu m/yr overhead-irrigation water is being saved, and a further 50-100 cu m/ha saving is expected. A program to increase storage space for liquid manure, dung water, and dung by 1985 is being developed in cooperation with water management organizations. Increasing the content of dry matter in liquid manure is important for effective fertilization, and this begins with using the least possible amount of water in animal-products plants and separate collection of plant wastewater. A system of standards for the preparation and utilization of liquid manure is being developed to be binding from 4/1/1983. Water pollution caused by careless use of fertilizers can be avoided with well-chosen agricultural methods while retaining high crop yields; this is important, since it will be necessary to utilize 0.5 million ha of land in water-conservation areas for agriculture in future. (Gish-IVI)
W84-04786

WATER DEMAND STANDARDS IN DAIRY FARMING (WASSERBEDARFSNORMEN IN DER RINDERPRODUKTION),
Akademie der Wissenschaften der DDR, Iden-Rohrbeck. Inst. fuer Rinderproduktion.
For primary bibliographic entry see Field 6D.
W84-04787

INFORMATION AND RECOMMENDATIONS ON TOPICAL QUESTIONS CONCERNING WATER CONSERVATION BY MEANS OF SOIL TREATMENT WITH WASTEWATER (INFORMATIONEN UND EMPFEHLUNGEN ZU AKTUELLEN FRAGEN DES GEWASSERSCHUTZES DURCH ABWASSERBODENBEHANDLUNG),
For primary bibliographic entry see Field 5D.
W84-04788

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

STREAMFLOW LOSSES AND CHANGES IN GROUND-WATER LEVELS ALONG THE SALE AND GILA RIVERS NEAR PHOENIX, ARIZONA - FEBRUARY 1978 TO JUNE 1980,
Geological Survey, Tucson, AZ. Water Resources Div.
L. J. Mann, and P. B. Rohne, Jr.
Available from the Ofss, USGS, Lakewood, CO 80225, Price: $5.75 paper copy, $5.00 microfiche. USGS Water-Resources Investigations report 83-4043, April, 1983. 11 p, 6 Fig, 3 Tab, 3 Ref.

Descriptors: *Streamflow, *Channel loss, *Groundwater levels, Infiltration rate, Groundwater development, *Arizona, Phoenix, Salt River, Gila River.

From March 1978 to June 1980, high runoff from the Salt and Verde drainage basins combined with large carryover storage in a reservoir system led to the release of about 8.26 million acre-feet of water. About 2.89 million acre-feet of the water was diverted above Granite Reef Dam, and about 5.45 million acre-feet was released into the normally dry channel of the Salt River. The total streamflow losses in the 74-mile reach between Granite Reef and Gillespie Dams were at least 474,000 acre-feet. Most of the water infiltrated into the permeable alluvial deposits along the Sal and Gila Rivers and increased the amount of ground water in storage. From February 1978 to May 1980, ground-water levels in 169 wells that tap the alluvial deposits in the Salt River Valley rose an average of 35.5 feet. The rise in ground-water levels was a direct result of the infiltrating floodwaters and a marked decrease in ground-water pumpage. (USGS)
W84-04264

SEVERN ESTUARY - AN APPRAISAL OF WATER QUALITY,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
For primary bibliographic entry see Field 5A.
W84-04332

32-P UPTAKE IN THREE SUBMERGED AQUATIC PLANT SPECIES,
Visva-Bharati Univ., Santiniketan. Dept. of Botany.
S. Jana, and M. A. Choudhuri.
Hydrobiological Bulletin, Vol. 17, No. 2, p 97-101, December, 1983. 2 Tab. 19 Ref.

Descriptors: *Plant growth, *Aquatic weed control, Phosphorus, Macrophytes, India, Kinetin, Ethrel, ABA, Growth regulators.

The uptake of 32-P at various developmental stages of three macrophytes (Potamogeton pectinatus, Vallisneria spiralis, Hydrilla verticillata) was measured. The effects of three growth regulators on this process was quantified: kinetin, a senescence inhibitor, ethrel and ABA, both senescence promoting substances. The highest 32-P uptake was noted among the young shoots of the plant species; the lowest by the old ones. Kinetin pretreatment increased the uptake while ethrel and ABA decreased it in all species. P-32 was transported to the largest extent to the young shoots of the submerged plants and to the smallest extent to the old ones by kinetin pretreatment. Kinetin enhanced the uptake most in Hydrilla shoots, followed by Vallisneria and Potamogeton. Ethrel diminished uptake most in Potamogeton shoots and to the smallest extent in Hydrilla, while ABA lowered it most in Hydrilla shoots and to the least in Potamogeton. (Baker-IVI)
W84-04376

VEGETATION LINED CHANNEL DESIGN PROCEDURES,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
J. E. P. Green, and J. E. Garton.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 436-439, March-April, 1983. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Channels, *Vegetation, Linings, Design criteria, Stability, Flow, Velocity.

Graphical and numerical design procedures for the design of vegetation-lined trapezoidal, parabolic, and triangular channels are presented. The procedures are based upon the Manning formula and the n-VR relationships of vegetation linings for five retardance classes. The numerical solution presented is an iteration process within the capabilities of a scientific pocket calculator. The graphical design procedure can be executed rapidly and compares favorably with numerical solutions. The numerical and graphical design results for more than 240 parabolic and trapezoidal channels were subjected to a linear regression analysis. There were no significant differences between the design values of depth and velocity of flow determined by means of the numerical of graphical procedures. The graphical procedure is also extremely flexible. Starting with the maximum permissible velocity, the optimum channel width and depth of flow can be determined. The maximum discharge capacity of an existing channel can be determined quickly and conveniently in the field as well. This method should allow designers to consider many alternative designs that might otherwise go unconsidered. (Baker-IVI)
W84-04427

DRAINAGE NEEDS AND RETURNS IN NORTH-CENTRAL IOWA,
R. S. Kanwar, H. P. Johnson, D. Schult, T. E. Fenton, and R. D. Hickman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 2, p 457-464, March-April, 1983. 2 Fig, 6 Tab, 14 Ref.

Descriptors: *Drainage, *River basins, Des Moines River, Water management, Crop yield.

Current status of drainage and estimated drainage needs of the soils in the Des Moines River basin as indicated from an extensive survey are presented. Ninety-five percent of the area in the basin lies within low-success districts with inadequate district mains. Of this area, 69% already has a high level of on-the-farm drainage systems designed at 1.27 cm drainage coefficient at the field level. Therefore, it only district mains in the low-success districts are improved from the present low level of drainage to a high level of drainage, more than 80% of the potential benefits could be received in low-success districts. If individual farmers have to make an investment for drainage improvement on their farms, very poorly drained and poorly drained soils should be considered first because these soils give the highest benefit/cost ratios, particularly for corn and soybean production. (Baker-IVI)
W84-04429

OPTIMAL IRRIGATION DISTRIBUTION SYSTEMS WITH INTERNAL STORAGE,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
M. J. Khanjani, and J. R. Busch.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 743-747, May-June, 1983. 3 Fig, 7 Tab, 10 Ref.

Descriptors: *Irrigation systems, *Farm service reservoirs, *Water storage, Optimization, Linear programming, Mixed integer programming, Cost analysis, Water conveyance, Water distribution.

A method was developed for planning an irrigation distribution system with internal storages that would supply water on a modified demand schedule so that adequate farm deliveries could be made during a portion of each day as demanded. By using internal farm service reservoirs, continuous flow into and through much of the system is possible with the reservoirs being used to store water for limited periods of time. This stored water can then be used on demand by irrigators. The method specifies the optimal sizes and locations of farm service reservoirs within an irrigation system. The resulting optimal plan is the least cost system for temporarily storing water so that irrigators can obtain irrigation water upon demand during a fraction of each day and thereby used water more effectively. Mixed integer programming is used in conjunction with linear programming to produce optimal plans for an irrigation conveyance and distribution system incorporating farm service reservoirs. The locations and sizes can be specified for the reservoirs used to temporarily store irrigation water. The procedure used can incorporate different constraints that deal with physical, management, and insittutional aspects. (Moore-IVI)
W84-04435

DEWATERING DREDGED SEDIMENT FOR AGRICULTURE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
W. D. Lembke, J. K. Mitchell, J. B. Fehrenbacher, and M. J. Barcelona.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 805-808 and 813, May-June, 1983. 7 Fig, 2 Tab, 8 Ref.

Descriptors: *Dewatering, *Lake sediments, *Land disposal, *Dredging, *Reservoirs, *Drainage, Lake Paradise, Illinois, Terrace channels, Tile outlet terraces, Sand filters, Water supply, Water quality control, Soil erosion.

Artificial impoundments for water supply can be dredged to remove sediments and restore their capacity. In many cases, the sediment in the lakes is the result of soil erosion from adjacent farm land. The feasibility of using lake bed sediment for agricultural production was investigated, using sediment from Lake Paradise, once the water supply for Mattoon, Illinois. Lake bed sediments was used in two studies: a hauled sediment study using relatively dry sediment having 23% clay and a hydraulically dredged sediment study using sediment having 30% clay. The hauled sediment plots produced a significantly higher corn yield than the check plots. The corn of the check plots showed a more severe moisture stress during a dry period in July. The additional organic matter on the hauled sediment plots provided a greater water holding capacity. The high water content of the sediment below the crust on the hauled sediment plots provided a water supply for the corn during the stress period in July. The increased yield of the hauled sediment plots provides an incentive for using the lake bed sediments in terrace channels on eroded soil where reduced yields are frequently a problem. The combination of tile outlet terraces and sand filters over subsurface drains was an effective method of dewatering sediment in terrace channels. The terraces prevented the sediment from returning to the lake and also substantially reduced further erosion of the watershed. The surface inlets removed the supernatant during the sedimentation process and removed surface water during consolidation of the sediment. The dewatering process occurred with a minimal effect on lake water quality. (Moore-IVI)
W84-04444

COST FUNCTIONS OF WATER CONVEYANCES FOR GRAVITY IRRIGATION,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
R. C. Yadav.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1090-1096 and 1101, July-August, 1983. 4 Fig, 7 Tab, 12 Ref.

Descriptors: *Water conveyance, *Gravity irrigation, *Cost analysis, *Open channels, *Pipelines, Conveyance structures, Irrigation projects, Mathematical equations.

In gravity irrigation systems, conveyance of water from a source to the point from which it can be fed into the field distributions system is a problem which can be solved by several technical methods, including open channels on raised earthen embankments, open channels elevated on piers, and underground pipelines. In the proposed method, water is conveyed through pipe to a suitable point beyond which it can be conveyed in an open channel. The point where switching from pipe to open channel is located where the cost of conveyance through pipes becomes higher than through open channel. The most economical conveyance using underground pipe and open channel in a definite proportion can conveniently be designed with the mathematical expression that comprises unit costs of work and materials and some easily determined coefficients and exponent values for an irrigation project. The overall saving (expressed as percent cost of conveyance with unlined channel) with the combined system so designed for a particular case was 82% as against 80% with underground pipe and 72% with lined open channel. (Moore-IVI)
W84-04452

WATER DISTRIBUTIONS WITH INITIAL STATIONARY SETS IN TRAVELER IRRIGATION,
Auburn Univ., AL. Dept. of Agricultural Engineering.
E. W. Rochester.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1105-1108, July-August, 1983. 9 Fig, 3 Tab, 3 Ref.

Descriptors: *Sprinkler irrrigation, *Traveler irrigation, *Application rates, *Stationary sets, Simulation, Wetting arc, Lane length, Travel speed.

A series of digital simulations was conducted to determine the effect of an initial stationary set on traveler irrigation application depths. Sprinkler wetting arcs were varied from 360 to 180 degrees. One sprinkler application-rate distribution was obtained for a Rain Bird 205 G sprinkler with a ring orifice and the second was a uniform application-rate pattern having the same flowrate and wetting radius as the Rain Bird sprinkler. Initial stationary set can extend the effective lane lengths in traveler irrigation. Extending the effective lane length with stationary sets decreases the volume of water discharged beyond the effective field boundary. Extending the effective lane length with stationary sets increases the volume of excess water applied to the field area. Total non-utilized water remains relatively constant for initial stationary sets which produce L/R values values less that 0.4 but increases for larger L/R values. Decreasing the sprinkler wetting arc from 360 degrees decreases the required delay time and the total volume of non-utilized water. The location where excess water is applied is midway between travel lanes and near the non-end affected field region. Decreasing the sprinkler wetting arc from 360 degrees to 180 degrees causes the position of the excess wetted zone to be shifted toward the start end of the field. Lane spacing has no effect on the volume of non-utilized water as long as travel speeds and delay time are used to provide the same average application depth and effective field boundary. (Moore-IVI)
W84-04454

DISTRIBUTION OF IRRIGATION WATER FROM A LOW PRESSURE, LATERAL-MOVING IRRIGATION SYSTEM,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
T. A. Howell, and C. J. Phene.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1422-1429 and 1434, September-October, 1983. 13 Fig, 3 Tab, 22 Ref.

Descriptors: *Lateral-moving irrigation systems, *Low pressure irrigation, Irrigation water, Distribution, Spray losses.

Fundamental considerations for irrigation water applications from lateral-moving irrigation systems are presented. The application dynamics are discussed relative to low-pressure, lateral-move irrigation machines. A prototype low pressure, lateral-move irrigation system was evaluated by testing several applicator systems for low volume, frequent irrigations. Results indicated that static uniformity coefficient exceeded 0.98. However, the dynamic uniformity coefficient was about 0.90. Pressurization requirements can be reduced to less than 200 kPa (possibly as low as 100 kPa) with little reduction in uniformity. The spray losses (both drift and evaporation) from the low pressure, overhead spray systems were about 10%. System alignment and, particularly, system speed control appear important to achieving uniform applications with low-pressure, lateral-moving systems. Additional research on speed control technology appears desirable. (Author's abstract)
W84-04469

SPRINKLER IRRIGATION DESIGN FOR UNIFORMITY ON SLOPES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
I.-P. Wu, and H. M. Gitlin.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1698-1703, November-December, 1983. 4 Fig, 1 Tab, 11 Ref, 1 Append.

Descriptors: *Slopes, *Sprinkler irrigation, Conveyance structures, Mathematical equations, Sprinklers.

Simple design procedures are introduced for sprinkler laterals (or submain) for uniform down slopes and non-uniform situations. The developed design chart for lateral or sub-main design on uniform down slope situations can be used to design required line size and also used for checking the acceptability of a design of the selected line size. The design requires only the line length, total discharge, operating pressure, slope and limited calculation. The pressure variation along a lateral (or submain) can be determined by combining the friction drop and energy gain (or loss) by slopes. When the number of sprinklers is 5 or more, the dimensionless energy gradient curve is close to the curve for an infinite number of outlets (sprinklers), so the dimensionless energy curve derived by assuming infinite outlets can be used to calculate friction drop pattern along the lateral or submain.

The primary object is to include slope effects in the design of sprinkler systems. (Moore-IVI)
W84-04477

COMPUTER MODEL FOR MOISTURE DISTRIBUTION IN STRATIFIED SOILS UNDER A TRICKLE SOURCE,
Clemson Univ., SC. Dept. of Agricultural Engineering.
C. F. Armstrong, and T. V. Wilson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1704-1709, November-December, 1983. 7 Fig, 4 Tab, 24 Ref.

Descriptors: *Trickle irrigation, *Soil water, *Computer models, Simulation, Stratified soils, Wetting front, Application rate, Permeability coefficient.

This research was conducted to: (1) develop a computer simulation model - or use an existing one - to simulate irrigation in stratified soils, (2) study the moisture distribution under a trickle source in a Lakeland sand, and (3) compare results of the computer model with field measurements. Field tests were conducted at various application rates and volumes, a CSMP model was modified for use in stratified soils, and this modified program was used to simulate irrigation in the Lakeland soil. The neutron scattering method was used to measure the moisture distribution to a depth of 150 cm and to a radius of 105 cm from the trickle emitter. For each test, measurements were made before and after irrigation and again after some redistribution period. Also, tensiometers were placed at specified depths at a radius of 45 cm to help locate the wetting front during application and redistribution. Input data for the CSMP simulation model (in-situ tension vs. water content and hydraulic conductivity vs. water content for each soil horizon) were obtained using the instantaneous profile method. Field measurements showed that the shape and size of the wetted zone is more a function of the volume of water applied than of the rate of application. When more than 32 L were applied, the additional water did not greatly increase the horizontal dimension of the wetted zone, but moved vertically through the profile. The CSMP simulation compared favorably with the field measurements in the Lakeland sand. (Author's abstract)
W84-04478

STORAGE LOSSES IN RESERVOIRS,
For primary bibliographic entry see Field 8A.
W84-04667

THE ACHIEVEMENTS OF CUBAN WATER MANAGEMENT - 20 YEARS OF WASTE MANAGEMENT IN THE REPUBLIC OF CUBA (DIE ERRUNGENSCHAFTEN DER KUBANISCHEN WASSERWIRTSCHAFT - 20 JAHRE WASSERWIRTSCHAFT IN DER REPUBLIK KUBA),
K.-H. Schroder, and J. Klein.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 93-95, March, 1983. 4 Ref.

Descriptors: *Water management, *Cuba, Water supply, Sewer systems, Irrigation, Flood control, Water conveyance, Reservoirs, Groundwater recharge.

Participants of the Conference of Heads of Water Management Agencies of COMECON member countries, which took place in Cuba in September 1982, were able to see at first hand the results of water management in Cuba and to enjoy an in-depth experience exchange concerning its future directions. True development of water management in Cuba began only after the revolution with the founding of the National Institute for Water Management in 1962. Primary goals were accelerated development of the water infrastructure and supplying of the rural and urban population with drinking water. Achievements of the past 20 yr include the supply of 60% of the population with drinking water and a sewer system serving one-third of wastewater, construction of reservoirs with a capacity of almost 6.5 billion cu m, utilization by means of reservoirs of 5.27 billion cu m of an estimated 14.7 billion cu m usable surface water, and work on a project for the artificial enrichment of groundwater to increase the estimated supply 1.1 billion cu m to 7.5 billion cu m. The area of irrigated agricultural land is to be increased from the present 1.2 million hectares to 1.75 million in 1990 and 2.23 million in the year 2000. In the area of flood control, 600 km of dams, 800 km of drainage channels, and 800 km of river regulating channels have been built. A study of chief polluters is in progress. A network of 705 measuring stations is being constructed (317 are complete) to aid in user-initiated rational water use. For the future, goals include economic regulation in water management, more even distribution of water resources, and optimization of agricultural water use through modernization of procedures and equipment. (Gish-IVI)
W84-04781

4B. Groundwater Management

NITRATE CONTAMINATION OF SUBSURFACE WATERS IN AN URBANIZING AREA,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W84-04227

ESTIMATING 1980 GROUND-WATER PUMPAGE FOR IRRIGATION ON THE HIGH PLAINS IN PARTS OF COLORADO, KANSAS, NEBRASKA, NEW MEXICO, OKLAHOMA, SOUTH DAKOTA, TEXAS, AND WYOMING,
Geological Survey, Denver, CO. Water Resources Div.
F. J. Heimes, and R. R. Luckey.
Available from the Ofss, USGS, Lakewood, CO 80225; Price: $5.75 in paper copy, $4.50 in microfiche. USGS Water-Resources Investigation Report 83-4123, 1983. 36 p, 7 Fig, 7 Tab, 9 Ref.

Descriptors: *Water use, *Irrigation, *Consumptive use, *Remote sensing, Groundwater, Discharge measurement, Instruments, Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, Wyoming, *High Plains aquifer, Pumpage, Irrigated cropland.

Current ground-water use is required for the High Plains Regional Aquifer-System Analysis. In response to this need, a sampling approach was developed to estimate water pumped for irrigation on the High Plains during 1980. Pumpage was computed by combining application estimates with mapped irrigated-acreage information. Irrigation application (inches of water applied) was measured at 480 sites in 15 counties in the High Plains during the 1980 growing season. The relationship between calculated Blaney-Criddle irrigation demand and measured application was used to estimate application for unsampled areas of the High Plains. Application estimates multiplied by irrigated-acreate estimates, compiled from Landsat-satellite imagery, yielded the volume of ground water pumped for irrigation. The estimate of ground water pumped for irrigation in the High Plains during 1980 and 18,902,000 acre-feet for 13,715,000 irrigated areas. The sampled application data were evaluated for significant trends. The application was greater for crops requiring more water such as corn and hay and less for crops such as sorghum, grain, and cotton. The data showed greater application for flood-irrigated systems than for sprinkler-irrigation systems. Areas of the High Plains with thin saturated thickness tended to have a smaller average discharge per well, fewer irrigated acres per well, and a predominance of crops requiring less water crops. (USGS).
W84-04257

STREAMFLOW LOSSES AND CHANGES IN GROUND-WATER LEVELS ALONG THE SALE AND GILA RIVERS NEAR PHOENIX, ARIZONA - FEBRUARY 1978 TO JUNE 1980,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 4A.
W84-04264

A DIGITAL-COMPUTER MODEL OF THE BIG SIOUX AQUIFER IN MINNEHAHA COUNTY, SOUTH DAKOTA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-04271

A GROUNDWATER MODEL FOR SIMULATING THE RISE OF WATER TABLE UNDER IRRIGATED CONDITIONS,
Haryana Agricultural Univ., Hissar (India).
R. Singh, S. K. Sondhi, J. Singh, and R. Kumar.
Journal of Hydrology, Vol. 71, No. 1-2, p 165-179, March, 1984. 4 Fig, 7 Tab. 8 Ref.

Descriptors: *Water table fluctuations, *Model studies, *Irrigation practices, Farming, Water table, Pumpage, Groundwater, Lower Ghaggar Basin, Haryana, India, Canals, Irrigation canals, Drinking water, Water demand.

During the last two decades, land-use of the major portion of Ghaggar River basin in the Haryana State of India has been transformed from dry-land agriculture to irrigated farming. A groundwater simulation model is used to predict the dynamic behavior of the water table in response to groundwater pumpage and net recharge in a part of the Lower Ghaggar basin. The pumped water is proposed to be used together with canal water for irrigation of crops and for drinking water demands considering the quality constraints. The study was conducted at the Farm of Haryana Agricultural University, an area of 1300 ha, to find management practices for controlling the rising water table. (Baker-IVI)
W84-04306

MALMESBURY GROUNDWATER SCHEME,
Wessex Water Authority, Bristol (England).
For primary bibliographic entry see Field 5F.
W84-04310

BOREHOLE RECHARGE OF THE FOLKESTONE BEDS AT HARDHAM, SUSSEX, 1980-81,
Southern Water Authority, Worthing (England). Resources Section.
M. J. O'Shea.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 9-24, February, 1984. 9 Fig, 2 Tab, 19 Ref.

Descriptors: *Groundwater recharge, *Boreholes, *Sussex, *England, Aquifers, Water supply, Water resources development, Borehole geophysics.

The results of short-term experimentation into borehole recharge carried out by the Southern Water Authority in an abstraction/recharge borehole at Hardham pumping station are presented. The Folkestone Beds aquifer varies in thickness in the area of study from 24 to 70 m and consists of medium to fine-grained, poorly or moderately cemented quartzose sands. Borehole recharge of fully treated river water into the Folkestone Beds culminated in a month's continuous recharge at 48l/s. The dual-purpose, single-main recharge/abstraction borehole incorporated a downhole valve to control recharge rates and to prevent air entry into the aquifer. Two boreholes lined with narrow-diameter, water-filled, galvanized steel tubes were specifically constructed to detect recharge movement by temperature logging. Chemical analyses of numerous water samples, together with geophysical logging, showed the wholesale displacement of groundwater by recharge water with little or no change in water chemistry. Little evidence existed of borehole clogging although small, short-lived turbidity peaks were associated with post-recharge abstraction, with or without simultaneous backwashing through the six backwash tubes. (Baker-IVI)
W84-04317

ORGANIC CONTAMINANT BEHAVIOR DURING RAPID INFILTRATION OF SEC-

ONDARY WASTEWATER AT THE PHOENIX 23RD AVENUE PROJECT,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04353

BENEFITS FROM GROUNDWATER MANAGEMENT: MAGNITUDE, SENSITIVITY AND DISTRIBUTION,
California Univ., Riverside.
E. Feinerman, and K. C. Knapp.
American Journal of Agricultural Economics, Vol. 65, No. 4, p 703-710, November, 1983. 2 Tab, 25 Ref.

Descriptors: *Groundwater management, *Benefits, *Kern County, *California, Taxes, Economic aspects, Cost-benefit analysis, Cost analysis, Irrigation, Water management.

Empirical estimates of benefits from groundwater management are reported for an area in California with heavy reliance on groundwater supplies. Benefits were quite sensitive to the water demand schedule and interest rate but less sensitive to other parameters. Either quotas or pump taxes can be used to achieve efficient groundwater withdrawals in the aggregate. However, there were dramatic differences in the distributional consequences. Groundwater users gain under quotas but suffer heavy losses under taxes. The sensitivity analysis provided alternate estimates of benefits from management in Kern County. It suggested how management benefits will change as economic and water supply conditions change. Benefits from management can be expected to increase as energy costs rise. Benefits from groundwater mangement were calculated to be $116 per irrigated acre in Kern County. This represents a 14% increase in the net benefits from groundwater use compared to no regulation and a 6% increase in the net benefits from both ground and surface water use. The relevant guideline for instituting groundwater management is that benefits exceed the costs. (Baker-IVI)
W84-04416

A SYSTEM FOR MANAGING WATER IN FINE TEXTURED SOILS,
Agricultural Research Service, Baton Rouge, LA.
C. E. Carter, J. E. Irvine, and C. R. Camp.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 767-771, May-June, 1983. 8 Fig, 7 Ref.

Descriptors: *Groundwater management, *Louisiana, *Drainage, *Subsurface irrigation, Silty clay, Silt loam, Water table, Water management, Drought, Groundwater movement, Soil texture.

A water management system, which compensates for erratic rainfall was tested on silty clay and silt loam soils in Louisiana. With monthly rainfall in the State varying from 0 to more than 375 mm and with annual average rainfall of about 1400 mm, a water management system which would drain excess water from the soil during rainy, wet periods and add water to the soil by subirrigation during droughts was needed. The system that was tested consisted of bordered areas in which subsurface drains were installed. The drains were connected to sumps equipped with pumps, valves, and switches for removing drain outflow. This same system was used for irrigation by adding water to the sumps causing the water table to rise into the root zone. The system was first tested on 40 sq m concrete bordered plots during 1967-1972 at Baton Rouge, LA, and later on 0.4 ha plastic bordered plots during 1979-1981 near Houma, LA. The success of the system was attributed to favorable water flow properties of the soil, borders which restricted the lateral movement of water to and from the bordered area, and the presence of a natural water table, usually within the top 1.2 m of the soil profile, which prevented excessive water losses due to percolation during irrigations. (Author's abstract)
W84-04439

SHALLOW SUBSURFACE DRAIN PERFORMANCE IN CLERMONT SOIL,
Agricultural Research Service, Columbia, MO.
N. R. Fausey.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 782-784, May-June, 1983. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Subsurface drainage, *Clermont soils, *Crop yield, Corn, Water table, Drawdown, Water quality.

The Clermont series consists of deep, nearly level, poorly drained soils. Subsurface drains were installed at 45 to 50 cm depth in Clermont silt loam soil with good surface drainage. The drains were 50 mm diameter corrugated plastic tubing installed on a slope of 0.33 to 0.38%. Water table elevations, drain flow rates, drain water quality and corn yields were measured over a 3-year period. Water table measurements showed the zone of drawdown occurred mostly within 3 m of the drain line although corn yields indicated an effect to about 6 m. Corn yields were increased an average of 0.85 metric tons/ha over the period by the subsurface drains. The drains removed about 28% of the rainfall during the study period. The drains showed minimal sediment accumulation, no structural deformation and the outflow water was of good quality. (Moore-IVI)
W84-04442

SUGARCANE YIELD RESPONSE TO SUBSURFACE DRAINAGE FOR AN ALLUVIAL SOIL,
Agricultural Research Service, Florence, SC.
C. R. Camp, and C. E. Carter.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1112-1116, July-August, 1983. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Subsurface drainage, *Sugarcane, *Drainage effects, *Louisiana, Crop yield, Alluvial soils, Rainfall, Water table.

A field study was conducted on an alluvial soil in Louisiana to determine the yield response of sugarcane to various subsurface drainage treatments that included three drain spacings (6.1, 12.2, and 24.4 m) and two drain depths (0.9 and 1.4 m). Annual rainfall was above the long-term mean during one year (1975) of the three-year study and was much lower than mean annual rainfall during the other two years (1974, 1976). All subsurface drainage systems adequately controlled the water table. Sugarcane and sugar yields for the subsurface drained treatments were significantly higher than yields for the undrained treatment during the wet year (1975) when the water table in the undrained treatment was very high during much of the year. The lower yield for the undrained treatment during the wet year was due primarily to lower plant population. Although yield increases were obtained for only one year, the magnitude of the increase for that year was large enough to defray a significant portion of the system installation cost. (Author's abstract)
W84-04456

OPTIMAL ANNUAL OPERATION OF A COASTAL AQUIFER,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
U. Shamir, J. Bear, and A. Gamliel.
Water Resources Research, Vol. 20, No. 4, p 435-444, April, 1984. 8 Fig, 5 Tab, 10 Ref.

Descriptors: *Optimization, *Coastal aquifer, Model studies, Multiple objectives, Linear programming, Groundwater management, Israel.

Optimal annual operation of a coastal aquifer is determined by using a multiple objective linear programming model based on a multicell model of the aquifer and a network representation of the hydraulic distribution system. The decision variables are pumping and/or recharge quantities in each cell. Four objective functions are based on (1) a desired groundwater surface map, (2) a desired location of the sea water-fresh water interface toe in each coastal cell, (3) a desired concentration map of a selected conservative contaminant, and (4) minimization of the energy for pumping and recharge. An approximate linearized expression of the location of the interface has been developed to enable the use of linear programming as the optimization method. A trade-off procedure is employed for identifying the most desirable solution. The model is applied to a segment of the coastal aquifer in Israel (a 44-km strip along the coast with a width of 7 to 15 km) and results are discussed. The operation is very tightly constrained for the presently existing wells and hydraulic system. Therefore the multiple objective decisionmaking process is rather limited in scope; after one round of single objective optimizations a final (compromise) solution can be selected. (Murphy-IVI)
W84-04567

EDV-SUPPORTED CALCULATION OF GROUNDWATER DRILLING INSTALLATIONS WITH THE GROUNDWATER DRILLING PROGRAM PACKAGE - PART 2 (EDV-GESTUTZTE BERECHNUNG VON GRUNDWASSERABSENKUNGSANFAGEN MIT DEM PROGRAMMPAKET GRUNDWASSERABSENKUNG - TEIL 2),
Ingenieurhochschule Cottbus (German, D.R.). Sektion Technologie der Bauproduktion.
For primary bibliographic entry see Field 8A.
W84-04783

4C. Effects On Water Of Man's Non-Water Activities

HYDROLOGY AND SUBSIDENCE POTENTIAL OF PROPOSED COAL-LEASE TRACTS IN DELTA COUNTY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
T. Brooks.
USGS Water-Resources Investigations Report 83-4069, 1983. 27 p, 5 Fig, 4 Tab, 22 Ref.

Descriptors: Hydrologic data collections, Water-quality data collections, *Subsidence, Aquifer characteristics, *Aquifers, Perched aquifers, Unconsolidated aquifers, *Coal mining, Data, *Springs, Streams, *Wells, Mesaverde Formation, North Fork Gunnison River valley, Gunnison River drainage, Delta County, *Colorado.

Potential subsidence from underground coal mining and associated hydrologic impacts were investigated at two coal-lease tracts in Delta County, Colorado. Alteration of existing flow systems could affect water users in the surrounding area. The Mesaverde Formation transmits little ground water because of the neglibile transmissivity of the 1,300 feet of fine-grained sandstone, coal, and shale comprising the formation. The transmissivities of coal beds within the lower Mesaverde Formation ranged from 1.5 to 16.7 feet squared per day, and the transmissivity of the upper Mesaverde Formation, based on a single test, was 0.33 foot squared per day. Transmissivities of the alluvium ranged from 108 to 230 feet squared per day. The transmissivity of unconsolidated Quaternary deposits, determined from an aquifer test, was about 1,900 feet squared per day. Mining beneath Stevens Gulch and East Roatcap Creek could produce surface expressions of subsidence. Subsidence fractures could partly drain alluvial valley aquifers or streamflow in these mines. (USGS)
W84-04262

INFILTRATION THROUGH RECONSTRUCTED SURFACE MINED SPOILS AND SOILS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
A. D. Ward, L. G. Wells, and R. E. Phillips.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 821-830 and 832, May-June, 1983. 10 Fig, 1 Tab, 5 Ref.

Descriptors: *Strip mine wastes, *Land reclamation, *Infiltration, *Kentucky, Topsoil, Spoil banks, Mine wastes, Soil water, Soil texture, Density, Rainfall rate.

An extensive series of tests involving reconstructed profiles of spoil and topsoil material from a Western Kentucky surface mine site was conducted with a laboratory infiltrometer system. Infiltration through the reconstructed spoil profiles was very low despite the coarse nature of the material. Low infiltration rates could be attributed to the material having a well-graded texture and to the high densities of the profiles. Infiltration through topsoil horizons was controlled, for the most part, by conditions at the surface. Following wetting, infiltration rates were primarily controlled by the hydraulic characteristics of the less permeable subhorizon of the spoil material. Except in very early stages, rainfall rate had little effect upon infiltration rate (or volume) through the spoil and topsoil profiles. Infiltration was, however, significantly influenced by initial moisture content and density. (Author's abstract)
W84-04445

4D. Watershed Protection

SOIL CONSERVATION WITH UNCERTAIN REVENUES AND INPUT SUPPLIES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
R. A. Kramer, W. T. McSweeny, and R. W. Stavros.
American Journal of Agricultural Economics, Vol. 65, No. 4, p 694-702, November, 1983. 4 Tab, 29 Ref.

Descriptors: *Soil conservation, *Decision making, *Economic aspects, Risk analysis, Model studies, Nonpoint pollution sources, Water pollution control, Soil erosion.

Annual soil loss in the United States due to sheet and rill erosion exceeds two billion tons annually. A major portion of the loss comes from agricultural and forest lands, contributing to the nonpoint source pollution of the nation's waterways and depleting the productive capacity of the land. The influence of risk on farm level soil conservation decisions is examined. A symmetric quadratic risk-programming model is used which allows the simultaneous consideration of uncertainty in revenues and input supplies. The generalized mean-variance model can be applied in realistic setting by means of symmetric quadratic programming. Compared to the more conventional quadratic risk-programming formulation, symmetric quadratic programming allows the conservation of an additional element of risk: uncertain limiting resources. Initially the model was solved without restrictions on soil loss. When regulatory constraints on erosion were analyzed it was determined that even a 25% reduction in soil loss generated substantial cuts in income. Risk aversion can influence the selection of soil conserving activities. (Baker-IVI)
W84-04415

PROTECTION OF SOILS FROM EROSION THROUGH STRIP CROPPING,
Ye. V. Poluektov.
Soviet Soil Science, Vol. 15, No. 1, p 79-85, 1983. 7 Tab, 7 Ref. Translated from Pochvovedeniye, No. 2, p 111-117, 1983.

Descriptors: *Erosion control, *Soil water, *Strip cropping, Erosion, Vegetation, Seasonal variation, Meltwater, Storm runoff, Wheat, Grass, Soil physical properties.

Factors were studied which retard the flow of meltwater and stormwater in strips of various crops in the northern part of the Azov Chernozem region. The area investigated has broken terrain with weighted-average slopes of 2.0 degrees. The depth of local base level of erosion is about 100 m. Snowcover at the end of the winter season is 8-15 cm deep. Water about 60 mm deep flows when the snow melts in the spring. Irregular compaction of plowed land during plowing and sowing of winter crops causes the amount of melt water runoff to vary. While flow generated in belts of winter wheat and perennial grasses is weak, it is almost absent from friable plowed land. The higher permeability of soils in plowed strips completely or partially retards and absorbs flow entering from compacted soil. During the summer the vegetative cover in strips having dense crop cover and the diversity of hydrophysical characteristics of soils in the strips, serve to retain flow originating from rainstorms. When a dense cover of plants decreases the runoff rate, the soil is improved by deposited material brought from fallow or tilled land on higher strips. More effective hydrophysical properties of the soil in combination with a dense network of cracks permit absorption of a significant quantity of water. (Baker-IVI)
W84-04518

MOISTURE AND SALT TRANSFER PROCESSES DURING MULCHING OF BARE FALLOW,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
S. M. Pakshina.
Soviet Soil Science, Vol. 15, No. 1, p 113-120, 1983. 2 Fig, 1 Tab, 13 Ref. Translated from Pochvovedeniye, No. 2, p 85-92, 1983.

Descriptors: *Soil water, *Mulching, Evaporation, Erosion control, Leaching, Salts, Nutrients, Droughts, Fallowing, Calcium, Hydrogen ion concentration.

The mechanism of moisture, salt and nutrient transfer processes were examined in a leached Chernozem mulched with straw or hydrophobic soil. Quantitative assessments were made of vapor and liquid moisture flows during evaporation. The following features became clear during moisture evaporation from mulched soil. First, evaporation losses of soil moisture are determined in the first stage mainly by liquid flow of moisture. Secondly, from the moment the soil under mulch dries and a dried layer is formed, evaporation is determined by vapor flows under the action of temperature gradients during the night time and relative humidity gradients in the soil air. The optimization of microbiological proceses during mulching affected the chemical composition of the soil. The pH level decreased and nitrate concentration and solubility of calcium carbonate increased. This makes it very important to mulch Solonchaks and Solonetz-like soils. Mulching not only mitigates the severity of droughts by preserving soil moisture but also speeds up reclamation of these soils by decreasing the pH and increasing mobile calcium ions. (Baker-IVI)
W84-04519

EXPERIENCES IN THE INTEGRATION OF WATER MANAGEMENT FACILITIES INTO THE LANDSCAPE USING TREES (ERFAHRUNGEN BEI DER EINBINDUNG WASSERWIRTSCHAFTLICHER ANLAGEN),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
H. Eisenreich.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 126-129, April, 1983.

Descriptors: *Landscaping, *Trees, *Water treatment facilities, *Wastewater treatment facilities, Bushes, Dams, Watersheds, Cost analysis, Water management, Buildings.

Large water-management structures such as dams and their service buildings, waterworks, and wastewater treatment facilities are usually foreign bodies in an organic landscape and often change it drastically. In order to lessen these effects, it is necessary not only for afforestation in dam catchment areas but also to plant trees and bushes to integrate the buildings themselves with the landscape. This has the added advantage of replacing cost- and maintenance-intensive lawns and flower beds with cheap and care-free shrubbery. Suitable species are suggested. In 1971 and 1972, the forestry engineer of a German Democratic Republic Water Management Area inspected various facilities in his area and made suggestions for planting. Two to three years later, it was determined that the suggestions had not always been followed, and some large trees that were too near buildings had to be removed (these obscure the view of facilities that must be observed). The planting of firs on the downstream side of a dam is described; in this case it was planned to use some of the trees for lumber after 12-15 years. Maintenance-free pasture can also be used in a case like this. To keep maintenance to a minimum, fast-growing species should be chosen, which quickly cover the ground. It is cheaper to plant fast-spreading species further apart despite higher maintenance costs than to plant them closer together, when costs for planting and soil preparation are high. Costs for a lawn are 160-310 Marks/100 sq m, whereas those for trees and bushes are 35-408 Marks/100 sq m. When new facilities are designed, plans for planting should be included. (Gish-IVI)
W84-04789

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINATION OF METHYLGERMANIUM SPECIES IN NATURAL WATERS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY WITH HYDRIDE GENERATION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
G. A. Hambrick, III, P. N. Froelich, Jr., M. O. Andreae, and B. L. Lewis.
Analytical Chemistry, Vol. 56, No. 3, p 421-424, March, 1984. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Methylgermanium, *Natural waters, *Atomic absorption spectrometry, Chemical properties, Optimization.

Inorganic and methylgermanium species are determined in aqueous matrix at the parts-per-trillion level by a combination of hydride generation, graphite furnance atomization, and atomic absorption spectrometry. The germanium species are reduced by sodium borohydride to the corresponding gaseous germanes and methylgermanium hydrides, stripped from solution by a helium gas stream, and collected in a liquid-nitrogen-cooled trap. The germanes are released by rapid heating of the trap and enter a modified graphite furnace at 2700 degrees C. The atomic absorption peak is recorded and electronically integrated. The absolute detection limits are 155 pg of Ge for inorganic germanium (GeI), 120 pg of Ge for monomethylgermanium (MMGe), 175 pg of Ge for dimethylgermanium (DMGe), and 75 pg of Ge for trimethylgermanium (TMGe). The precision of the determination ranges from 6% for TMGe to 16% for MMGe. Results of the analyses of natural waters are presented. (Author's abstract)
W84-04194

LIQUID CHROMATOGRAPHIC DETERMINATION OF AMMONIUM IN WATER,
Nara Prefectural Inst. of Public Works (Japan).
M. Mizobuchi, K. Tamase, Y. Kitada, M. Sasaki, and K. Tanigawa.
Analytical Chemistry, Vol. 56, No. 3, p 603-605, March, 1984. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Pollutant identification, *Ammonia, Water analysis, Wastewater analysis, Chromatography, High performance liquid chromatography, Ammonium fluorophor.

A method is described for the the determination of ammonium in environmental water samples by high performance liquid chromatography (HPLC) for the separation of the ammonium fluorophor from others. A total of 106 samples of river water, 20 effluents from wastewater treatment facilities and 16 rainwater samples were collected. All samples were filtered through acetylcellulose membranes. Up to 1.0 mL of the filtered sample was placed in a 10 mL test tube and made up to 2.0 mL with 0.2M borate buffer solution. Two hundred microliters of fluorescamine solution was added and the solution mixed vigorously for 20-30 sec until the color changed from white to light yellow. This solution was used for the analysis of ammoni-

um fluorophor by HPLC. A sample ranging from 5 to 20 microL was injected into the HPLC system. The concentration of ammonium was determined from the peak height by comparison to standards which were run throughout the procedure. The standard curve was linear in the concentration range of 0.2-5.0 micro g NH4(+)/2.2 mL. (Baker-IVI)
W84-04195

APPLICATION OF HENRIKSEN'S 'ACIDIFICATION INDICATOR' AND 'PREDICTOR NOMOGRAPH' TO TWO ADIRONDACK LAKES,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. R. Church, and J. N. Galloway.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 111-120, 1984. 3 Fig, 1 Tab, 22 Ref. Electrical Power Research Institute (EPRI) contract RP1109-5.

Descriptors: *Henriksen's Acidification Indicator, *Henriksen's Predictor Nomograph, *Lakes, *Adirondacks, Hydrogen ion concentration, Acidic rain, Environmental effects, Indicators, Input-output analysis, Chemical properties, Measuring instruments, Woods Lake, Panther Lake, Sagamore Lake.

During the period 1977--1980 the effects of highly acidic precipitation (mean pH 4.1 to 4.2) on the chemistry of three Adirondack lakes (Woods Lake, Panther Lake, and Sagamore Lake) were studied. Two of these lakes (Woods and Panther) are enough like those lakes of southern Sweden and Norway studied by Henriksen that they should constitute a valid test for his 'acidification indicator' and 'predictor nomograph'. Weekly samples were taken near the surface of the lakes during unstratified summer and fall conditions over a 3 yr period. The acidification indicator and predictor nomograph were developed using data from lake samples taken under similar conditions in Scandinavia. The principal finding is that with regard to the empirical line of the acidification indicator (that Henriksen found separated data from lakes receiving precipitation greater or less than pH 4.6) and with the precipitation pH axis of the predictor nomograph, these two methods of evaluation are not directly applicable 'as is' to Adirondack lakes. The reason for this is that the chemistry of precipitation in the Adirondacks is significantly different from (and for) which the acidification indicator and predictor nomograph were developed. In the Adirondacks, acids other than H2SO4 play a much greater role in the overall acidity of the precipitation. This causes relationships between precipitation pH and lake chemistry in the two regions to be different. (Murphy-IVI)
W84-04208

CONTINUOUS MEASUREMENT OF RADON EMANATIONS FROM SOIL AND GROUNDWATERS IN SOUTHERN FRANCE (ALPES MARITIMES). PRELIMINARY RESULTS (MESURE CONTINUE DES VARIATIONS DES EMANATIONS SOUTERRAINES DU RADON SUR TROIS SITES DES ALPES-MARITIMES (FRANCE). RESULTATS PRELIMINAIRES),
A. Oddou, L. Nault, R. Campredon, and M. Bernat.
Comptes Rendus Hebdomadaires, Seances Academie/Sciences Series II, Vol. 296, No. 14, p 1081-1086, April, 1983. 7 Fig, 17 Ref.

Descriptors: *Radon, *Soil chemistry, *Groundwater, *France, *Alpes-Maritimes, Measuring instruments, Performance evaluation, Ions, Ion transport, Trace levels.

Two types of automated instruments which monitor the emission of Radon from rocks and groundwaters are actually being set up in a few localities of the French-Italian Alpes-Maritimes (SE France). The first results obtained concerning the Alpes Maritimes confirm the reliability of the recorders with continuous alpha traces but the fact that the time period involved was short doesn't permit definitive conclusions to be made nor sound correlations to be established. It was not possible to determine the influence of the atmospheric, lithologic and structural parameters of Radon in the soil. Two types of detectors, the ionization chamber and the trace recorder, continuously measure the variations of Rn 222 in a natural environment permitting the study of all possible modes of transport of this gaseous fluid in the heart of geologic formations. Therefore, the combined use of these measuring instruments is necessary in order to exploit the major seismotectonic sites of a region. (Murphy-IVI)
W84-04285

VIROLOGICAL EXAMINATION OF DRINKING WATER: A CANADIAN COLLABORATIVE STUDY,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, M. Trudel, S. A. Sattar, V. S. Springthorpe, and T. P. Subrahmanyan.
Canadian Journal of Microbiology, Vol. 30, No. 1, p 105-112, January, 1984. 4 Tab, 24 Ref. Health and Welfare Canada grant 6606-1781-54, 6605-1649-54, 6606-1790-54.

Descriptors: *Virology, *Drinking water, *Canada, Wastewater analysis, Microscopic analysis, Reoviruses, Picornaviruses, Viruses, Water quality standards, Bacterial analysis, Turbidity, Residual chlorine, Montreal, Ottawa, Toronto.

A collaborative virological survey of drinking water was initiated in three major Canadian urban areas, Montreal, Ottawa, and Toronto. In each selected area, three water purification plants were sampled monthly for up to 18 months. The total population served by all nine plants was about 1,500,000. Samples of raw (100 L) and treated (1000 L) water were examined by virus concentration procedures based on adsorption-elution. Sample concentrates were assayed for cytopathic viruses on BS-C-1 cells and the results were expressed as the most probable number of cytopathic units (MPNCU). Viruses were detected in 57% (0-15.35 MPNCU/L) of the raw water samples from Montreal, 37% (0-46.0 MPNCU/L) in Ottawa, and 33% (0-4.91 MPNCU/L) in Toronto. The majority of isolates were reoviruses, but picornaviruses were also found. All finished waters (177 samples) met bacteriological, turbidity, and residual chlorine standards and were free of detectable viruses. (Author's abstract)
W84-04287

BUTYLTIN COMPOUNDS AND INORGANIC TIN IN SEDIMENTS IN ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
R. J. Maguire.
Environmental Science Technology, Vol. 18, No. 4, p 291-294, 1984. 4 Tab, 18 Ref.

Descriptors: *Butyltin, *Inorganic tin, *Sediments, *Ontario, Measuring instruments, Organotin compounds, tri-n-Butylmethyltin, di-n-Butyldimethyltin.

Organotin compounds are used as stabilizers for polyvinyl chloride, as catalysts, and as biocides. The increasing annual use of organotin compounds raises the possibility of environmental pollution. A method has been developed for the analysis of butyltin species and in organic tin in sediments, and the presence of these compounds in sediments in Ontario is reported for the first time. Although inorganic tin occurred frequently in sediments collected around the province, butyltin species were found mainly in the sediments of harbors, reflecting earlier findings on their occurrence in water, with which these findings are compared. Tri-n-butyltin, the most toxic of the butyltin species to aquatic life, was present at 0.5 mg/kg (dry weight) in the top 2 cm of sediment in Toronto Harbor. In addition, tri-n-butylmethyltin and di-n-butyldimethyltin were found in the sediment of a few harbors, indicating that some butyltin species can be methylated in aquatic environments. (Murphy-IVI)
W84-04292

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF BROMOXYNIL OCTANOATE AND METRIBUZIN IN RUNOFF WATER FROM WHEAT FIELDS,
Agricultural Research Service, Beltsville, MD. Yakima Agricultural Research Lab.
D. F. Brown, L. M. McDonough, D. K. McCool, and R. I. Papendick.
Journal of Agricultural Food Chemistry, Vol. 32, No. 2, p 195-200, March-April, 1984. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *High-performance liquid chromatography, *Chromatography, *Bromoxynil octanoate, *Metribuzin, *Wheat, *Agricultural Runoff, Herbicides, Measuring instruments.

A method for the direct determination of the herbicides metribuzin and bromoxynil octanoate and their metabolites DADK and bromoxynil by high-performance liquid chromatography (HPLC) was developed. Aqueous samples were frozen to simulate storage of field samples, thawed in a microwave oven to minimize time of exposure to room temperatures, acidified to pH 3.3, and extracted with dichloromethane/acetonitrile. Compounds were separated by HPLC on an octadecyl reverse-phase column with a water/methanol gradient and determined with a variable-wavelength ultraviolet detector. High-density polyethylene storage containers adsorbed 50-80% of the bromoxynil octanoate from solution, but satisfactory recoveries were obtained by extracting the freshly emptied containers with dichloromethane. In the range of 20-200 ppb, recoveries averaged 83-96%. At 25 ppb standard deviations were 4.8% form metribuzin, 4.0% for DADK, 6.2% for bromoxynil octanoate, and 1.4% for bromoxynil. Almost complete loss of bromoxynil octanoate occurred at room temperatures (20-25 degrees C) within 72 h, although no losses of the other three compounds were observed. Samples could be stored safely at -15 degrees C up to 300 days. (Author's abstract)
W84-04294

THE DETERMINATION OF LEAD AND CADMIUM BY ELECTROTHERMAL ATOMIZATION ATOMIC ABSORPTION UTILIZING THE L'VOV PLATFORM AND MATRIX MODIFICATION,
W. K. Oliver, S. Reeve, K. Hammond, and F. B. Basketter.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 460-470, October, 1983. 6 Fig, 5 Tab, 12 Ref.

Descriptors: *Pollutant identification, *Atomic absorption spectroscopy, *L'vov platform, Cadmium, Lead, Spectroscopy.

In monitoring potable waters for compliance with EEC Drinking Water Directives it is necessary to analyze for lead and cadmium using methods with detection limits of 5 and 0.5 microg/l, respectively. There is a need for a method with minimal bias and much more sensitivity than direct flame atomic absorption spectrophotometry; a nonflame technique with minimal sample preparation has obvious advantages. An approach is illustrated for critically evaluating the behavior of the L'vov platform and the normal tube in non-flame atomic absorption spectrophotometry. The importance of optimizing individual instruments is emphasized and the procedures for the optimization of instrumental parameters are discussed. The use of a matrix modifier was needed for a wide range of sample types. The L'vov platform with phosphoric acid as the matrix modifier provides suitable methods. The limits of detection were 2.0 and 0.125 microg/l for lead and cadmium, respectively. Spiking recoveries were between 95 and 105% at 25 and 2 micrograms/l lead and cadmium, respectively. (Baker-IVI)
W84-04312

MONITORING TECHNIQUES FOR THE ORGANIC QUALITY OF WATER,
R. A. Hyde, D. J. Rodman, and T. F. Zabel.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 25-38, February, 1984. 5 Fig, 4 Tab, 28 Ref.

Descriptors: *Monitoring techniques, *Water quality, *Organic compounds, Measuring instruments, Gas chromatography, Liquid chromatography, Review.

A review of the monitoring techniques available to the water industry for the control of organic chemicals in drinking water and the limitations of these methods is presented. As the cost of organics monitoring and control is high, the paper stresses the need to define clearly the objectives of the organics control strategy and to select the appropriate monitoring program to meet these objectives. The measurement of individual organic compounds such as trihalomethanes, group parameters such as total organic carbon, and the more advanced techniques using gas chromatography-mass spectrometry and high performance liquid chromatography is discussed. Microbiological techniques available for evaluating organic contaminants in drinking water, including mutagenic screening and ATP measurement are also outlined. (Murphy-IVI)
W84-04318

SEVERN ESTUARY - AN APPRAISAL OF WATER QUALITY,
Welsh Water Authority, Powys (Wales). Directorate of Scientific Services.
M. Owens.
Marine Pollution Bulletin, Vol. 15, No. 2, p 41-47, February, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Water quality control, *Severn Estuary, *England, Municipal wastewater, Dissolved oxygen, Nitrogen, Silicates, Suspended solids, Metals, Industrial wastes, Fisheries, Planning, Standards, Nutrients.

The Severn estuary is used extensively for effluent disposal. A program to establish the quantities of contaminants discharged to or entering the estuary was conducted in two phases: Phase 1 was a limited study, between June 1975 and March 1977, to provide estimates of the loads of various contaminants entering the estuary; Phase 2, between August 1977 and March 1979, more intensively the major inputs. Samples of river water and domestic and industrial effluents were analyzed for ammonia, silicate, orthophosphate, nitrite, total oxidized nitrogen, suspended solids, cadmium, copper, iron, lead, manganese, nickel, zinc, mercury, biochemical oxygen demand, particulate organic matter and dissolved organic matter. The data on chromium are incomplete because the chromium content of river waters was not determined. Water quality standard guidelines have been adopted for the main water body of the Severn Estuary. The Working Party determined that the standards should be based on the most sensitive uses of the estuary which included the maintenance and improvement of migratory fisheries and the protection of indigenous demersal fisheries and shellfisheries. Therefore the Severn Estuary Joint Committee has adopted as a policy that there should be no deterioration in overall water quality in the estuary. Since the evidence indicates that the existing concentrations of contaminants have not had any adverse effects, the standards as accepted are based on existing concentrations. (Baker-IVI)
W84-04332

COMPARATIVE STUDY OF THE CD, CU AND PB DETERMINATION BY AAS AND BY ICP-AES IN RIVER WATER; APPLICATION TO A MEDITERRANEAN RIVER (CONGOST RIVER, CATALONIA, SPAIN),
Barcelona Univ. (Spain). Dept. of Analytical Chemistry.
R. Rubio, J. Huguet, and G. Rauret.
Water Resources, Vol. 18, No. 4, p 423-428, 1984. 3 Fig, 6 Tab, 15 Ref.

Descriptors: *Spectrometry, *Atomic absorption spectrometry, *Heavy metals, *Congost River, *Spain, Pollutant identification, Cadmium, Copper, Lead, Trace elements.

The standard method for heavy metal determination in surface waters is based on atomic absorption spectrometry (AAS) measurements with a previous extraction with ammonium pyrrolidine dithiocarbamate-methyl isobutyl-ketone (APDC-MIBK) system. The inductively coupled plasma-atomic emission spectrometry (ICP-AES) technique is one of the best for trace element analysis in water due to the great sensitivity, selectivity, and minimum sample preparation work. The accuracy, precision, detection limit and rapidity in the determination of Cd, Cu and Pb in river water by AAS determination, previous extraction with APDC-MIBK system, is compared with direct determination method ICP-AES. Both methods show a similar detection limit and an analogous accuracy by the addition standard method. With a calibration curve only ICP-AES presents good accuracy. This technique is advantageous in long term precision and requires minimum sample preparation. Both methods are applied to the determination of Cd, Cu and Pb in Congost river water. In spite of the fact that the flow is low and the area is highly industrialized, all results are below the limits set by the Spanish standards on quality of surface water. The results obtained by the two methods are in disagreement, but they are acceptable considering that the values are near the detection limits and the great quantities of organic mattter present. (Moore-IVI)
W84-04350

FACTOR INTERACTIONS AND AQUATIC TOXICITY TESTING,
R. A. Voyer, and J. F. Heltshe.
Water Resources, Vol. 18, No. 4, p 441-447, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Toxicity, *Metals, *Interactions, *Aquatic animals, Water pollution effects, Model studies, Experimental design.

It is hypothesized that experimental variables constituting an exposure situation act independently when in combination. Two published data sets dealing with effects of metal mixtures on aquatic animals were reviewed in order to assess the potential practical significance of factor interactions and their implication to the design of aquatic toxicity tests. The data sets were re-analyzed using each of the following predictive models: simple-additive; linear-additive; and quadratic response. The relative effectiveness of each model in predicting joint effects of independent test variables was evaluated in terms of calculated mean-square error and goodness-of-fit (R2) values, as well as by how well predicted treatment effects compared with responses by original investigators. Analyses show that in one case all three models provided similar estimates that closely approximated observed responses, despite the presence of a statistically significant two-factor metal interaction. In the second instance, the quadratic response model effective predictor and was appreciably better than the linear-additive model in terms of the calculated parameters. The simple-additive model on the other hand, tended to over-estimate treatment effects, by as much as 80% in some instances, and was least effective of the three models examined. The working hypothesis is rejected, i.e. an assumption of factor independence is not to be accepted a priori. The presence of other possible lethal agents, together with those environmental parameters that may influence the chemistry of these agents and the physiology of test organisms need to be considered in designing test protocols. A sequential testing protocol should be used to evaluate the existence of factor interactions. (Moore-IVI)
W84-04351

CHIRONOMID DEFORMITIES AS INDICATORS OF POLLUTION FROM A SYNTHETIC, COAL-DERIVED OIL,
Oak Ridge National Lab., TN. Environmental Sciences Div.
R. M. Cushman.
Freshwater Biology, Vol. 14, No. 2, p 179-182, April, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Bioindicators, *Pollutant identification, *Chironomids, *Oil, Coal, Fuels, Coal liquid, Monitoring, Larvae, Toxicity, Teratogenicity.

If synthetic liquid fuels from coal become a commercial reality, then transportation and storage of these products will result in spills to freshwater habitats and consequent exposure of aquatic organisms. Larval Chironomus decorus (Diptera: Chironomidae), taken from experimental ponds to which a coal liquid had been added, were found to have deformities of the mentum. The percent occurrence of all deformities ranged from 2.7 to 4.6%, with an overall mean of 3.3%. Percent occurrence was independent of dose, although the highest percent occurrence was observed at the high dose. However, the percent occurrence of medial deformities, while only 1.9% at the high dose, was related to dose. Even so, the efficacy of using medial deformities as monitors for pollution by coal liquids is questionable. Traditional measures of toxicity to the benthic insect community may be more effective than the occurrence of deformities as an indicator of coal liquid contamination. (Baker-IVI)
W84-04373

2,2'-DIAMINODIETHYLAMINE CELLULOSE POWDER FOR TRACE METAL PRECONCENTRATIONS FROM WATER,
Antwerp Univ., Wilrijk (Belgium). Dept. of Chemistry.
G. Reggers, and R. Van Grieken.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 317, No. 5, p 520-526, March, 1984. 1 Fig, 5 Tab, 19 Ref.

Descriptors: *Water analysis, *Pollutant identification, Preconcentration, 2,2'Diaminodiethylamine cellulose powder, Cellulose powder.

Cellulose powder with 2,2'-diaminodiethylamine (DEN) functional groups exhibits efficient complexation of transition metal cations. Collection yields above 85% are obtained up to a chelation capacity of 1.5 meq per gram. The cellulose-DEN powder is insensitive to abundant substances like alkali and alkaline earth ions, and humic matter. Some cations can be eluted efficiently in a small volume of HNO3. Compared to preconcentration by filtration through cellulose-DEN filters, the use of cellulose-DEN powder offers higher chelation capacities, hence potentially higher enrichment factors in combination with, for example, neutron activation analysis. Since re-elution of the collected trace elements with small volumes of acids seems practical for selected elements only, the use of this preconcentration technique with flame atomic absorption analysis can be used for a number of elements but, for multielement analysis, the procedure is not promising. (Baker-IVI)
W84-04375

EXPERIENCE IN MONITORING DOMESTIC WATER SOURCES AND PROCESS WATERS FOR TRACE ORGANICS,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering.
J. S. Zogorski.
Journal of Environmental Science and Health, Vol. A19, No. 2, p 233-249, February, 1984. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Monitoring, *Organic compounds, *Drinking water, Water supply, Quality control, Gas chromatography.

A strategy is presented for monitoring municipal drinking water sources, process waters, and distribution waters for the presence of selected organic compounds, both volatile and non-volatile. The monitoring strategy and associated analytical procedures evolved in conjunction with organic monitoring investigations for several cities in Indiana and Kentucky. The interest in monitoring water supplies and finished waters by water utilities evolved from a relatively narrow focus of detecting for volatile organic compounds (trihalomethanes) to a very broad task of determining the identity and concentration of hundreds of individual organic compounds of an industrial origin. A brief description is offered for the gas chromatographic methods used to measure to presence of indicator organic compounds. The heavy reliance on gas chromatography in completing the approach has resulted in considerable cost savings to

municipalities while still meeting various monitoring needs, in comparison to total reliance on GC/MS testing. This procedure may be especially useful to water utilities who are just commencing the difficult task of collecting information about organic contaminants that may be present in their water supply and drinking waters. The approach is predicated on the assumption that a subset of indicator compounds can provide a representative picture of the overall organic contamination situation for a particular utility. (Baker-IVI)
W84-04387

HEAVY METAL CONTENT AND LITHOLOGICAL PROPERTIES OF RECENT SEDIMENTS IN THE NORTHERN ADRIATIC,
Venice Univ. (Italy). Facolta di Chimica Industriale.
R. Donazzolo, O. H. Merlin, L. M. Vitturi, and B. Pavoni.
Marine Pollution Bulletin, Vol. 15, No. 3, p 93-101, March, 1984. 9 Fig, 3 Tab, 10 Ref.

Descriptors: *Heavy metals, *Sediments, *Seawater, Adriatic Sea, Mercury, Lead, Cadmium, Copper, Chromium, Nickel, Cobalt, Zinc, Iron.

Heavy metal concentrations, textural characters and mineralogical compositions have been determined on 246 surface sediment samples from the Northern Adriatic Italian sea area. The relationship between the heavy metals content and the pelite percentage has been studied. Comparing relationships between heavy metals contents and some properties of sediments such as fine fraction composition, specific surface area and accumulation level in the pelite, some elements (Hg, Cu, Ni, and Fe) showed a fairly good similar degree of correlation with all these variables. Others (Cr, Zn, Pb, and Cd) even though accumulated in the fine fraction, do not have a good correlation with pelite and specific surface area. Cobalt has a low accumulation in the fine fraction, no significant correlation with the pelite and poor correlation with the specific surface area. (Baker-IVI)
W84-04394

MEASUREMENTS OF THE CONCENTRATION IN RAINWATER AND OF THE HENRY'S LAW CONSTANT OF HYDROGEN PEROXIDE,
Tokyo Metropolitan Research Inst. for Environmental Protection (Japan).
K. Yoshizumi, K. Aoki, I. Nouchi, T. Kobayashi, and S. Kamakura.
Atmospheric Environment, Vol. 18, No. 2, p 395-401, 1984. 9 Fig, 3 Tab, 62 Ref.

Descriptors: *Rainwater, *Henry's Law Constant, *Hydrogen peroxide, *Measuring instruments, Chemistry of precipitation, Chemical properties, Air pollution, Tokyo, Japan.

Recently H2O2 has been of great concern as a termination reaction product of hydroperoxyl radical in photochemical chain reactions in the atmosphere. In addition, the reaction of S(IV) with H2O2 in rainwater has been considered to be a major process by which atmospheric SO2 is converted to sulfate. A chemiluminescent method for measuring hydrogen peroxide was developed using hemin as a catalyst for luminol-based H2O2 oxidation, which gave a detection limit below 0.1 microg/t in the solution. The most atmospheric species did not give serious interference, and that negative interference of SO2 could be eliminated if pH of the collecting solution was above 10 whereas O3 gave significant positive interference. The Henry's law constant of H2O2 was experimentally determined to be 1.42 x 105 M/atm at 20 degrees C at ambient concentration levels of H2O2. This method was also applied to the measurements of H2O2 concentration in rainwater in Tokyo, Japan, which was in the range of 5-1065 microg/t. (Murphy-IVI)
W84-04537

IN VITRO CHOLINESTERASE INHIBITION OF ORGANIC MATTER IN URBAN AND RURAL RIVER SEDIMENT,
Science Univ. of Tokyo. (Japan). Faculty of Pharmaceutical Sciences.
M. Tabata, E. Bannai, H. Nishizono, and S. Suzuki.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 1, p 391-399, April, 1984. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Sediments, *Cholinesterase inhibition, *Pollutant identification, *Japan, Rivers, Urban areas, Organic matter.

The inhibitory effect of solvent extracts of urban and rural river sediment on cholinesterase in vitro was examined. Sediment samples were collected from the surface layer in five urban rivers (the Tsurumi, Meguro, Sumida, Ara, and Ayase Rivers), and five rural rivers which run through the paddy field region near Kujukuri beach. Sediments were dried and the samples obtained were extracted twice every 8 hr with a mixture of n-hexane (Hex) and distilled water. Next they were extracted using ethyl acetate and distilled water and then methanol. Dose response curves of cholinesterase inhibition of urban or rural river extracts are shown. The inhibitory effect on ChE of each extract was weak. The Hex extracts showed the weakest effect. It is apparent that each extract inhibited ChE, because ChE inhibition increased as dose levels increased for the extracts. (Baker-IVI)
W84-04544

DETERMINATION OF VOLATILE HALOCARBONS IN WATER BY PURGE-CLOSED LOOP GAS CHROMATOGRAPHY,
Harbor Branch Foundation, Inc., Fort Pierce, FL.
T. Wang, and R. Lenahan.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 429-438, April, 1984. 5 Fig, 5 Tab, 8 Ref.

Descriptors: *Pollutant identification, *Gas chromatography, *Halogenated hydrocarbons, Volatile compounds, Water analysis, Organic compounds.

Concentrations of volatile halocarbons in water at the parts per billion level have been determined using gas chromatography in conjunction with Hall electrolytic conductivity, electron capture detection or flame ionization. When a water sample that contains organic compounds is placed in a closed-loop system, organics will equilibrate between the water and the headspace during the purging period. Distribution of componds between the two phases depends on temperature, vapor pressure for each compound, sample matrix influences on compound activity coefficients, ratio of headspace to liquid volume in the entire closed system, purge time and gas purge rate. The time and method used to equilibrate samples will affect gas chromatographic responses. Since the purge and trap technique is currently popular, a brief comparison was conducted between this method and the purge-closed loop method. The results were not significantly different and both methods delivered a relative standard deviation of less than 10%. (Baker-IVI)
W84-04545

ORGANOCHLORINE RESIDUE LEVELS IN MISSISSIPPI RIVER WATER SNAKES IN SOUTHERN LOUISIANA,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
T. D. Sabourin, W. B. Stickle, T. C. Michot, C. E. Villars, and D. W. Garton.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 460-468, April, 1984. 3 Tab, 17 Ref.

Descriptors: *Organochlorine compounds, *Snakes, *Mississippi River, *Louisiana, Baton Rouge, Belle Helene, Organic compounds, DDT, HBC, Lindane, Aldrin, Endrin, Heptachlor epoxide, Polychlorinated biphenyls, Pesticide residues, Biological magnification.

The usefulness of water snakes for pollution monitoring was investigated by assessing the organochlorine load in tissues of snakes inhabiting three sites along the Mississippi River near Baton Rouge, Louisiana. The levels of PCB's, DDT and its metabolites and other organochlorine residues (dieldrin, heptachlor epoxide, hexachlorobenzene, heptachlor, hexachlorobenzene, endrin, and lindane) in the individual tissues are summarized. Highest concentrations detected were in the fat bodies, intermediate levels were located in liver samples and lowest concentrations in muscle tissue. No correlation existed between organochlorine load and sex, length or weight. The concentration of HCB was significantly greater in snakes of both species taken from Belle Helene, by a ten fold increase over snakes taken from the other areas. The Belle Helene sampling area lies within an area which received considerable attention in 1973 for HCB contamination of cattle. Use of the snakes appears to be a promising method of monitoring water pollution. (Baker-IVI)
W84-04547

MEASURING POLLUTION USING MAGNETISM,
Liverpool Univ. (England). Dept. of Botany.
R. Maxted.
Water and Waste Treatment, Vol. 27, No. 3, p 47, March, 1984.

Descriptors: *Path of pollutants, *Pollutant identification, *Magnetism, Erosion, Sediment transport, Wastewater disposal, Magnetic tracing, Magnetic studies, Monitoring, Iron oxides.

A whole new range of instruments and sensors has been developed which uses the presence of iron oxides to establish rates, chronologies, and distribution of pollution and sediment. Both natural and artificial processes produce iron oxides which are magnetic, chemically stable, and specific to their source and mode of formation. High temperatures are used to convert iron compounds in natural materials to magnetic oxides. The heat treatment can be applied successfully to all particle sizes from coarse gravel to fine silt or even clay. Magnetic tracing has been used to determine the effects of floods and the movement of many industrial and municipal wastes by seeding the effluents. The use of mineral magnetism can confer a number of advantages in terms of time and spatial scale in many monitoring programs. (Baker-IVI)
W84-04558

BOD RESULTS THAT ARE BELIEVABLE,
Environmental Engineering Consultants, Inc., Stillwater, OK.
E. L. Stover, and D. E. McCartney.
Water Engineering and Management, Vol. 131, No. 4, p 37-40, 62, 66, April, 1984. 4 Fig, 5 Ref.

Descriptors: *Wastewater analysis, *Biochemical oxygen demand, Monitoring, Nitrification, Dissolved oxygen, Wastewater treatment, Bioassay.

The BOD5 test is not a measure of the quantity of organic material in wastewater, but instead is a bioassay procedure for assessment of the amount of oxygen required for the respiratory functions of the microorganisms in the BOD bottle. Biological inhibition of the heterotrophic (carbonaceous) microorganisms can cause low BOD values while, on the other hand, nitrification during the five-day test period can cause high values to be observed. Dissolved oxygen depletion due to the dilution water itself can influence the variability observed during BOD determinations. The following general rules should make BOD test results less variable and increase the confidence placed in them by the testers. Use acclimated seed material with complex wastewaters. Inhibit nitrification when appropriate. Determine seed demand and dilution water depletions with multiple dilutions. Apply appropriate correction factors. Dilution water correction can be calculated according to the amount of dilution water used if desired. Select seed concentration to yield between 0.2 and 1.0 mg/l oxygen demand. During data interpretation, place greater emphasis on sample volumes with higher total depletion. The influences of water and seed corrections are minimized during the calculation of these BOD values. Best sample volumes for BOD calculations are those with net depletions between 25 and 75% of the initial DO values. Place more

emphasis on sample volumes with greater than 2.0 mg/l net depletion. Plot BOD versus sample volume to determine inhibition. Use sample volumes below the threshold inhibition level for BOD calculations. (Baker-IVI)
W84-04559

SPECTROPHOTOMETRIC DETERMINATION OF TOTAL TRIHALOMETHANES IN FINISHED WATERS,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
J. Y. C. Huang, and G. C. Smith.
American Water Works Association Journal, Vol. 76, No. 4, p 168-171, April, 1984. 4 Tab, 22 Ref.

Descriptors: *Spectrophotometry, *Trihalomethanes, *Treated water, Sodium hydroxide, Pyridine, Gas chromatography, Comparison studies, Chlorination, Performance evaluation.

Research into a spectrophotometric method for measuring total trihalomethanes in drinking water is described. The procedure is based on the classic Fujiwara reaction, which is characterized by the red color that develops when a halogen compound is heated with sodium hydroxide and pyridine. This method can provide a semiquantitative screening of THMs at water treatment plants that are not equipped with a GC. This technique would be especially useful for water utilities that have limited laboratory budgets but are trying to compare trends in THM concentration or rank the THM content of different samples. Although less sensitive and less specific than gas chromatography, this method is relatively simple and inexpensive and could be used in water treatment plant laboratories to screen for total trihalomethanes in finished waters. (Murphy-IVI)
W84-04586

COMPUTER STORAGE AND EVALUATION OF WATER QUALITY BIOLOGICAL DATA,
Nottingham Univ. (England). Dept. of Zoology.
R. T. Joy.
Environmental Pollution (Series B), Vol. 6, No. 1, p 1-14, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Computers, *Computer programs, *Water quality, *Biological samples, Trent biotic index, Community diversity index, Performance evaluation.

Computer programs were employed to merge the data from a series of samples of macro-invertebrate fauna and to calculate cumulative values of Trent Biotic and Community Diversity Indices. While the values of both indices are related to the degree of pollution present in the water, they are also dependent upon sample size. It is suggested that water quality may be adequately assessed by either index value calculated for a standard sample containing 1000 organisms. When cumulative data are pooled from a range of locations differing widely in the degree of pollution it is apparent that the two indices are highly correlated with each other. It is concluded that the Trent Biotic Index is a semiquantitative rather than a qualitative parameter. (Author's abstract)
W84-04615

USE OF WATER QUALITY INDEX FOR RIVER CLASSIFICATION AND ZONING OF GANGA RIVER,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Environmental Pollution (Series B), Vol. 6, No. 1, p 51-67, 1983. 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Water quality index, *River classification, *River zoning, *Ganga River, Water quality standards, Model studies, Water pollution control, Computers.

The practice of river classification on the basis of standards is difficult to apply because, in many cases, not all water quality variable values satisfy the corresponding limits set for a single class of use. In such situations, it would be simpler and more rational to classify a river for a given use on the basis of an index derived to include the integrated effect and relative importance of each relevant variable in the given use. Criteria and methodology for evolving such quality indices and limits of significant variables for the different grades of the various beneficial uses of a water are proposed. The simplified model for the Water Quality Index (WQI) has been used to evaluate the WQI values of the River Ganga for its various uses. The use of WQI is exploited for the classification and zoning of Ganga. The river standards for pollution control and water quality management can also be prescribed in terms of the WQI. (Author's abstract)
W84-04617

ARSENIC, GOLD AND MERCURY CONCENTRATION LEVELS IN FRESHWATER FISH BY NEUTRON ACTIVATION ANALYSIS,
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
C. L. Ndiokwere.
Environmental Pollution (Series B), Vol. 6, No. 4, p 263-269, 1983. 2 Tab, 10 Ref.

Descriptors: *Arsenic, *Gold, *Mercury, *Fish, *Neutron activation analysis, Bioaccumulation, Niger River, Niger Delta, Nigeria.

Elemental concentrations of arsenic, gold and mercury have been determined in flesh tissues of freshwater fish species from some Nigerian rivers. The technique of neutron activation followed by radiochemical separation of the isotopes of interest has been applied. The concentrations of 0.04-0.87 microg/g and 0.4-1.33 microg/g obtained for gold and mercury, respectively, in the samples are much higher than the values reported in the literature for freshwater fish. The arsenic concentration range of 0.07-0.42 microg/g is within the reported range. The high concentration levels of these heavy metals can be attributed to local contamination of the rivers. (Author's abstract)
W84-04621

DETERMINATION OF LOWER HALOGENATED HYDOCARBONS BY THE WATER-XYLENE EXTRACTION METHOD,
Yokohama National Univ. (Japan). Inst. of Environmental Science and Technology.
M. Inoko, M. Tsuchiya, and T. Matsuno.
Environmental Pollution (Series B), Vol. 7, No. 1, p 129-140, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Water-xylene extraction method, *Halogenated hydrocarbons, Performance evaluation, Drinking water, Water analysis, Hydrocarbons, Trace levels.

A modified liquid extraction method for determining trace amounts of lower halogenated hydrocarbons in drinking water has been studied. A 45 ml sample solution containing not less than 5 microg/liter of CHCl3, CHCl:CCl2, CHBrCl2, CHClBr2, CHBr3 and CCl2:CCl2 and 0.4 microg/liter of CCl4 was extracted with 5 ml of xylene. The equilibrium concentrations of lower halogenated hydrocarbons in the xylene phase were determined by a gas chromatograph equipped with an electron capture detector and using a column which consists of tricresylphosphate (90 cm), squalane (170 cm) and silicone DC 200 (40 cm). By means of this method, microg/liter levels of lower halogenated hydrocarbons in drinking water were determined successfully. (Author's abstract)
W84-04627

CONSTRAINTS AND CATEGORIES OF VADOSE ZONE MONITORING DEVICES,
Kaman Tempo, Santa Barbara, CA.
For primary bibliographic entry see Field 7B.
W84-04640

SOME AQUATIC INSECTS AS WATER QUALITY INDICATORS IN THE RIVER KHAN,
Madhav Science Coll., Ujjain (India). Dept. of Zoology.
D. S. Rao, and A. B. Saxena.
International Journal of Environmental Studies, Vol. 20, No. 3/4, p 281-284, March, 1983. 1 Fig, 2 Tab, 9 Ref.

Descriptors: *Bioindicators, *Water analysis, *Aquatic insects, *River Khan, *India, Population dynamics, Rivers, Insects, Water quality.

The River Khan is is a shallow, turbulent river originating near the city of Indore. About eight million gallons of sewage and industrial wastes are discharged into the river daily. The insect community structure was used to evaluate water pollution in the River Khan. The different types of insect characterize the various saprobic zones in the river. Bearing in mind the physico-chemical conditions of water at the place of occurrence of the insects, various saprobic designations have been assigned to the insect groups. These studies reveal that the insect communities in the river give an approximation of the water quality conditions in the river. (Baker-IVI)
W84-04655

FLUORIDE CONCENTRATION IN THE WATER OF THE RIVER CAUVERY, KARNATAKA, INDIA,
Mysore Univ. (India). Dept. of Botany.
R. K. Somashekar, and S. N. Ramaswamy.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 325-327, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Fluoride, *India, *Karnataka, *River Cauvery, Water pollution effects, Public health, Aquatic life, Fish, Industrial wastes, Chemical industry, Pulp and paper industry, Bioaccumulation.

Cauvery is one of the important rivers of Karnataka with a total length of 1500 km. The water of this river is used for domestic as well as for industrial purposes all along its course. The survey for fluoride level was made at five sampling points stretching over a distance of about 25 km. Sampling station 3 receives large amounts of effluents from fertilizer and paper factories. The effluents of a fertilizer factory have an average fluoride concentration of 300 mg/l. The water of this river is unsuitable for domestic use at a few stations along its course because of the high fluoride concentrations. Fluoride rich water has also posed a threat to the bird sanctuary located at one of the sampling points. The higher concentrations of fluorides in this study are also known to accumulate in the aquatic biota and subsequently reach man through food chains, thus leading to health hazards in the area. (Baker-IVI)
W84-04661

METHOD FOR BIOLOGICAL QUALITY ASSESSMENT OF WATERCOURSES IN BELGIUM,
Ghent Rijksuniversiteit (Belgium). Lab. for Biological Research in Aquatic Pollution.
N. De Pauw, and G. Vanhooren.
Hydrobiologia, Vol. 100, p 153-168, April, 1983. 2 Fig, 7 Tab, 55 Ref.

Descriptors: *Water quality, *Measurement instruments, *Belgium, Bioindicators, Biological properties, Water quality standards, Sampling, Biotic index.

A description is given of the method generally used in Belgium to assess the quality of running water. It involves the determination of a biotic index with scores between 0 and 10, based on samples of the aquatic macro-invertebrate community collected in situ, using a handnet. The Belgian method combines the advantages of two existing biological assessment methods. Its major advantages are its simplicity, speed, reliability, low cost, and practical utility. Its limitations and difficulties as well as the needs for further research are briefly discussed. The method, called the Belgian Biotic Index Method, is applicable to various types of watercourses and has recently been proposed to the Belgian Institute for Normalization for approval as a standard method. For several years, the Belgian government has based its strategy towards

surface water sanitation on water quality maps, visualizing the biotic indices obtained by the biological assessment method. As such, Belgium is advancing the recommendations for biological water quality monitoring being worked out by the Environmental and Consumer Protection Service of the Commission of the European Communities. (Author's abstract)
W84-04689

ROTIFERS AS INDICATORS OF WATER QUALITY,
Prague Dept. of Water Technology (Czechoslovakia).
V. Sladecek.
Hydrobiologia, Vol. 100, p 169-201, April, 1983. 3 fig, 2 Tab, 193 Ref.

Descriptors: *Rotifers, *Bioindicators, *Water quality, Toxicity, Biological properties, Biological samples, Trophic level, Ecology, Saprobiology, Species diversity.

Six hundred and twenty species and lower taxonomical units of Rotatoria found in Czechoslovakia and surrounding countries are listed alphabetically and classified according to water quality. The numerical characteristics include the saprobic valence in 10 balls, the indicative weight of species (Ii) and the individual saprobic index (Si). Rotifers are considered to be good indicators. The situation is illustrated by four graphs and the relation to BOD5 values is stressed. All rotifers are aerobic organisms and occur only within limnosaprobity. They can also serve as indicators of trophic conditions. To characterize the situation in standing the slowly flowing waters a Brachionus:Trichocerca quotient is proposed. Rotifers can also be used as test organisms in toxicity experiments. (Murphy-IVI)
W84-04690

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES: 1: FONTINALIS ANTIPYRETICA HEDW.,
Durham Univ. (England). Dept. of Botany.
P. J. Say, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 245-260, April, 1983. 3 Fig, 11 Tab, 35 Ref. Department of the Environment contract DGR/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Fontinalis, Measuring instruments, Aquatic plants, Pollution load, Monitoring, Zinc, Manganese, Lead.

An account is given of methods developed to monitor heavy metals in rivers by measuring the concentration of these metals in Fontinalis antipyretica Hedw. Key features of the standard method recommended include the harvesting of materials from microhabitats with fast current speeds wherever possible, thorough washing in field and laboratory, use of terminal 2-cm lengths of shoot, drying at 105 degrees C and digestion in 2 M HNO3. In order to establish the extent to which this species is useful and to provide baseline data with which others can compare their own observations, samples of moss, water and sediments were harvested for analysis from 52 different sites in northern England and Belgium. Significant positive correlations were obtained between Cu and Zn in 2-cm tips and in both (total) water and sediment, but in the case of Cd and Pb only between 2-cm tips and sediment. Multiple stepwise regression was used to quantify the apparent influence of environmental variables. For instance, with PB in the moss as the dependent variable, significant influences were found for Zn in the moss (+ve) aqueous Mn (+ve) and filtrable reactive phosphate (-ve). Variables which were significant were incorporated in each case into equations to predict the concentration of metal that would be expected if allowance was made for the concentration of all these variables at each site. In the case of Pb, sq r = 0.075 for metal in moss versus aqueous metal, whereas sq r = 0.879 for metal in moss versus the predicted value for metal in moss. This suggests that the lack of correlation between Pb in moss and Pb in water was probably due largely to the influence of other variables. For Cd, the difference was less: sq r = 0.013 and sq r = 0.47, respectively. A principal components analysis was also carried out, with measurements of water and moss as the variables ordinated. An example is given of the use of the moss to monitor intermittent Zn pollution in R. Wear. (Author's abstract)
W84-04692

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES. 2: RHYNCHOSTEGIUM RIPARIOIDES,
Durham Univ. (England). Dept. of Botany.
J. D. Wehr, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 261-284, April, 1983. 8 Fig, 20 Tab, 38 Ref. Department of the Environment DGR/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Rhynchostegium, Measuring instruments, Monitoring, Aquatic plants, Pollution load, Copper, Zinc, Cadmium, Barium, Lead.

A study was made of general ecology and metal accumulation in the widespread aquatic moss Rhynchostegium riparioides, (Hedw.) C. Jens. with a view to developing the use of this species as a monitor of heavy metal pollution. In order to establish a data bank for statistical analysis, samples of water and moss were taken within a 6-week period from 105 sites (10-m reaches) in Northern England from streams and rivers of diverse physical and chemical types. Analyses were made of 14 metals (Na, Mg, K, Ca, Cr, Mn, Fe, Co, Ni, Cu, Zn, Cd, Ba, Pb) in both 2-cm tips and whole plants. The same 14 metals were also measured in both total and filtrable water, together with 12 other variables. Samples of tips were easier to prepare for analysis, but had significantly ($p < 0.001$) lower concentrations of all metals except Na and K. Significant correlations ($p < 0.001$) between metal in moss and aqueous metal were found for ten metals (Na, K, Mg, Ca, Mn, Cu, Zn, Cd, Ba, Pb). Correlations between metals in moss and in water were in general similar for tips and whole plants, but much higher for tips with Na, Zn and Cd; the relationship was quite similar whether total or filtrable water was considered, with the exception of Ba where the correlation was much higher with the latter. A multiple regression was used to suggest which variables in water and/or moss may influence accumulation of Co, Ni, Cu, Zn, Cd, Ba and Pb in the moss. For instance, the variables which had a very highly significant effect on Pb in tips were Pb, filtrable reactive phosphate and Zn in the water. A discussion is included of how the data may be used for monitoring purposes. (Author's abstract)
W84-04693

ACCUMULATION OF HEAVY METALS BY AQUATIC MOSSES. 3: SEASONAL CHANGES,
Durham Univ. (England). Dept. of Botany.
J. D. Wehr, and B. A. Whitton.
Hydrobiologia, Vol. 100, p 285-291, April, 1983. 5 Fig, 3 Tab, 9 Ref. Department of the Environment DRG/480/571.

Descriptors: *Bioaccumulation, *Heavy metals, *Aquatic mosses, *Seasonal variation, Measuring instruments, Monitoring, Pollution load, Amblystegium, Fontinalis, Rhynchostegium.

The changes taking place at seven stream and river sites over a 14-month period were followed for the following: 1) % cover of Rhynchostegium riparioides; 2) relative abundance of Rhynchostegium as part of the whole plant community and, where present, also Amblystegium riparium and Fontinalis antipyretica; 3) 18 water chemistry variables; 4) concentrations of nine metals in 2-cm tips of Rhynchostegium at all sites and of Amblystegium and Fontinalis at one site each. A decrease in the amounts of these mosses occurred in winter at most sites, the effect being most pronounced with Amblystegium. Nevetheless, the majority of plants which remained had healthy shoots suitable for sampling for metal analysis at all times of year. There were marked temporal changes in the concentrations of metals in the 2-cm tips at each site, but few of these appeared to be related to seasonal events. The most plausible was for Pb in Rhynchostegium at a main river site, where increased accumulation in winter was probably an indirect effect of other chemical differences in the water during a period of high flows. Provided healthy shoots were available, there was no indication of seasonal differences in metal accumulation resulting from features of the mosses themselves. (Author's abstract)
W84-04694

GAS CHROMATOGRAPHIC DETERMINATION OF TOTAL AMINO ACIDS AND PROTEIN IN SEDIMENTS USING THE NINHYDRIN-CO2 REACTION,
Freshwater Biological Association, Windermere (England).
B. M. Simon, and J. G. Jones.
Hydrobiologia, Vol. 101, No. 3, p 189-194, May, 1983. 3 Fig, 5 Tab, 18 Ref.

Descriptors: *Gas chromatography, *Amino acids, *Protein, *Sediments, *Ninhydrin, *Carbon dioxide, Measuring instruments.

Several methods have been used to determine total amino acids in water and soils. Some methods can be of limited use in anoxic samples, particularly sediments. A sensitive modification of the ninhydrin-CO2 method involving the gas chromatographic determination of the total protein and amino acid content of sediment is described. The method gives a linear response over the amino acid concentration range 0.00001 M to 4 x .01 M. It can be used for whole sediment, hydrolysates and interstitial water. The performance of the method is compared with the fluorescamine method for primary amines. (Murphy-IVI)
W84-04711

CHRYSOPHYCEAN CYSTS: INDICATORS OF EUTROPHICATION IN THE RECENT SEDIMENTS OF FRAINS LAKE, MICHIGAN, U.S.A.,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
H. J. Carney, and C. D. Sandgren.
Hydrobiologia, Vol. 101, No. 3, p 195-202, May, 1983. 11 Fig, 23 Ref.

Descriptors: *Chrysophycea, *Eutrophication, *Paleolimnology, *Frains Lake, *Michigan, Stratigraphy, Sedimentation, Bioindicators, Bioaccumulation.

The recent sediments of Frains Lake, Michigan contain a rich and well preserved association of chrysophycean cysts. Forty one forms are revealed by scanning electron microscopy (SEM) and light microscopy (LM). Taxonomic descriptions and SEM micrographs are provided for the dominant forms. The three dominant taxa throughout the sediments, Cysta minima, C. modica and C. subbavaricum, do not show significant shifts in proportional abundance associated with European settlement and the onset of cultural eutrophication. However, certain subdominant taxa do show clear trends. Density counts indicate a dramatic decline in cyst concentration (by volume and by dry mass) and a sharp increase in absolute accumulation (net annual influx) following settlement. The Frains Lake profile of chrysophycean cysts is compared to sequences of other North American and European temperature lakes. The utility of chrysophycean cysts as paleoenvironmental indicators is considered on the basis of these results. (Author's abstract)
W84-04712

CHEMICAL EXTRACTION OF HEAVY METALS IN POLLUTED RIVER SEDIMENTS IN CENTRAL EUROPE,
Technische Univ., Hamburg (Germany, F.R.).
W. Calmano, and U. Forstner.
The Science of the Total Environment, Vol. 28, p 77-90, June, 1983. 2 Fig, 3 Tab, 46 Ref.

Descriptors: *Heavy metals, *Sediments, Pollutant identification, Zinc, Cadmium, Lead, Copper,

Rhine River, Rotterdam Harbor, Weser Estuary, Neckar River, Extraction, Estuarine environment.

A five-step sequential extraction technique was used to determine the chemical association of heavy metals (Zn, Cd, Pb, Cu) with major sedimentary phases (exchangeable cations, easily and moderately-reducible compounds, organic/sulfidic phases, residual components) in samples from polluted rivers in Central Europe (Middle Rhine River, Lower Rhine/Rotterdam Harbor, Weser Estuary, Neckar River). Data gained suggest that the surplus of metal contaminants introduced into the aquatic system from anthropogenic sources usually exists in relatively unstable chemical forms. The more important accumulative phases for trace metals are found in the easily-reducible fractions. Extraction with acidified hydroxylamine solution seems to yield the metal fractions which may predominantly participate in short-term geochemical and biochemical processes. Rates of mobilization were significantly higher for zinc and cadmium than for copper and lead. (Author's abstract)
W84-04741

BROWN SEAWEED, FUCUS VESICULOSUS, AND THE GASTROPOD, LITTORINA LITTORALIS, AS INDICATORS OF TRACE-METAL AVAILABILITY IN ESTUARIES,
Marine Biological Association of the United Kingdom, Plymouth (England).
G. W. Bryan.
The Science of the Total Environment, Vol. 28, p 91-104, June, 1983. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Algae, *Gastropods, *Trace metals, *Bioindicators, *Estuarine environment, Silver, Cadmium, Lead, Zinc, Salinity, England, Wales, Fucus, Littorina, Bioavailability.

Fucus vesiculosus appears to be a good indicator of the bioavailable forms of Ag, Cd, Cu, Pb, Zn and probably other metals in seawater. Experimental concentration factors for Ag, Cu and Pb were similar at sea water concentrations differing by a factor of 10, but for Cd and Zn factors were lower at higher levels. With decreasing salinity, concentration factors for Cd tended to increase, but this was less evident for Zn, high concentrations of which substantially reduced Cd accumulation. Concentrations of 10 metals in Littorina littoralis from a range of sites in England and Wales were compared with those of F. vesiculosus on which it grazes. The gastropod was a good indicator of Cd contamination but was less useful than F. vesiculosus for most other metals. (Author's abstract)
W84-04742

QUANTITATION OF METAL COMPLEXES BY REVERSE-PULSE AMPEROMETRY AND MOLECULAR-EXCLUSION CHROMATOGRAPHY,
North Dakota Univ., Grand Forks. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W84-04770

5B. Sources Of Pollution

HEAT TRANSFER; ENVIRONMENTAL ASPECTS,
Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
A. M. Kanury.
Mechanical Engineering, p 28-39, June, 1983. 12 Fig, 12 Ref.

Descriptors: *Thermal pollution, *Environmental effects, Powerplants, Nuclear waste, Waste heat, Thermal powerplants, Thermal stratification, Stratification, Thermal stress, Heated plumes, Heat transfer, Water cooling.

Atmospheric and aquatic dispersion of heat, geothermal heat transfer, and management of process byproducts are explored. The demand for electric power has resulted in recent years in the construction of large numbers of big power plants throughout the world. For every unit of energy converted to eletricity, approximately two units are discharged into the environment. Among the major research problems currently faced in the design of evaporative cooling towers are: the effects of crosswinds upon draft, heat exchange, and drift entrainment of hot water droplets in the exhaust gas flow; the consequences of cold weather ice formation; fill heat and mass transfer coupling; and the internal aerodynamics of cooling tower flows that determine the pressure losses and heat transfer rates. Discussion is offered concerning aquatic and atmospheric stratification, heat disposal to water bodies, heat transfer in porous media, heat transfer in soils, and high level nuclear waste storage. (Baker-IVI)
W84-04199

THE BEHAVIOR OF BARIUM IN A LANDFILL AND THE UNDERLYING SOIL,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). Chemical Biological Div.
P. Lagas, J. P. G. Loch, C. M. Bom, and L. J. A. Gerringa.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 121-129, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Barium, *Landfills, Industrial wastes, Waste dumps, Leaching, Soil properties, Water pollution sources, Netherlands.

The behavior of Ba in a landfill and the soil was studied because at several locations in The Netherlands heat treatment waste from metal processing companies, containing Ba, was dumped in codisposal with domestic waste. Experiments were set up to study the behavior of Ba under controlled conditions; columns were filled with a layer of sand soil, on top of which a layer of ground domestic waste was placed. A layer of Ba-containing salt was imbedded in the waste. Special attention was given to the influence of the location of the Ba-containing salt in the waste layer and the influence of the groundwater level on the behavior of Ba. The results indicate that 18 to 39% of the Ba that was added to the columns leached, probably in the form of organic Ba-complexes. Part of the Ba was adsorbed or precipitated in the sand or the waste layer, while part of the Ba remained at the original place of application in the form of BaCO3. (Author's abstract)
W84-04209

DBCP RESIDUE STUDIES IN SOIL AND WELL WATER FROM TWO SOUTH CAROLINA PEACH ORCHARDS,
Clemson Univ., SC. Dept. of Plant Pathology and Physiology.
G. E. Carter, Jr., J. T. Ligon, and M. B. Riley.
Water, Air, and Soil Pollution, Vol. 22, p 201-208, 1984. 5 Tab, 8 Ref.

Descriptors: *1,2-Dibromo-3-chloropropane, *DBCP, *Peach orchards, *South Carolina, Water pollution, Water pollution sources, Pesticides, Contamination, Soil contamination, Nematodes.

The soil fumigant 1,2-dibromo-3-chloropropane (DBCP) was used to control ring and root-knot nematodes, both of which are major contributors to 'peach tree short life'. Soil samples collected from a peach orchard near a well containing 1 microg/kg (DBCP) (contaminated) and from a peach orchard with a well containing 0.1 microg/kg DBCP (uncontaminated) contained less than 0.1 microg/kg and 0.5 microg/kg DBCP residue, respectively. Soil profiles did not explain the presence of DBCP in the contaminated well. However, a possible spill of DBCP approximately 30 m from the contaminated well may have contaminated the well water. Soil samples taken at the site of the possible spill contained high concentrations of DBCP in the upper meter and at 6.1 m where the water table was encountered. The water contamination resulted from this spill of DBCP and not from normal agricultural use. (Murphy-IVI)
W84-04211

NITRATE CONTAMINATION OF SUBSURFACE WATERS IN AN URBANIZING AREA,
Case Western Reserve Univ., Cleveland, OH. Dept. of Geological Sciences.
G. Matisoff, J. M. Inglis, and W. R. Kelly.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159748, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Center Report OSURF No. 713266, Ohio State Univ., Columbus, September, 1983. 29 p, 6 Fig, 1 Tab, 24 Ref. Project No. OWRT A-066-OHIO (1).

Descriptors: *Groundwater, *Nitrates, *Chlorides, *Computer models, *Solute transport, Unconfined aquifers, Groundwater pollution, Groundwater level, Groundwater recharge, Groundwater movement, Geohydrology, Model studies, *Ohio, Lake County, Water pollution sources, Path of pollutants, Groundwater flow model, Solute transport model, Road salt runoff, Hydrogeology.

The ground water system in northern Perry Township in Lake County, Ohio is a shallow, unconfined aquifer consisting of glacial lake beach deposits and less permeable lacustrine plain deposits. Groundwater flow is generally from south to north, but strong, local variations are caused by northward flowing streams. The areal distributions of chloride and nitrate suggest that recharge is derived from local infiltration. Groundwater flow and solute transport models were used to simulate flow and pollutant transport in the study area under hydrologic steady-state rates of 0-4 feet per day which indicate that in excess of 27 years are required to obtain chemical steady-state. The simulations also demonstrate that nitrate loading must occur in more than one cultivated field and that a commercial nursery is not the sole source of contamination. Road salt run-off easily infiltrates the aquifer and can be readily described by the model. The results underscore the susceptibility of shallow aquifers to even modest surficial chemical contamination. In such cases it may be necessary to implement some types of land use control or to restrict the development of groundwater.
W84-04227

MODELING STREAMLINES AND MASS TRANSPORT IN CIRCULATING FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W84-04229

IRON SPECIATION IN ACID MINE EFFLUENTS: CHEMICAL AND MICROBIAL CONTROLS,
Ohio State Univ., Columbus. Dept. of Agronomy.
J. M. Bigham, O. H. Tuovinen, K. S. Brady, and T. J. Logan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159664, Price codes: A03 in paper copy, A01 in microfiche. Ohio Water Resources Center, Columbus Completion Report No. 714437, (1984). 29 p, 8 Fig, 3 Tab, 33 Ref. Project No. OWRT A-068-OHIO (1).

Descriptors: *Acid mine water, *Iron compounds, *Iron bacteria, *Oxidation, Chemical precipitation, Hydrolysis, *Ohio, Black Fork Creek watershed, Mine drainage, Bioreactors.

The Black Fork Creek watershed, located in Perry and Morgan Counties, Ohio, was selected as a representative field site for evaluating the solution chemistry of iron in streams receiving acid coal mine drainage. Water samples from a point source of acid discharge and a 2 km downstream section of the receiving stream were examined in detail. The total sulfate content, total iron content, Eh and pH of the acid effluent were 4500 microg/ml, 1250 microg/ml, + 584 mV and 2.9, respectively, at the time of sampling. Ferrous iron accounted for 95% of the total iron load. Both total and ferrous iron showed rapid, 10-fold decreases in the receiving stream even though pH of the stream water remained less than 3.5. The fraction of polymeric iron (greater than 0.1 microm esd) increased from 6% in the acid effluent to almost 50% of the total iron load at points farthest downstream. UV-spectroscopic analyses of the stream water indicated

that Fe(OH)(2+) and Fe2(OH)2(4+) may be important intermediate species in polymer formation. A laboratory bio-reactor was tested for potential use in the treatment of acid mine drainage. Cells of Thiobacillus ferroxidans were immobilized in an alginate matrix and used in a packed-bed column reactor for the continuous oxidation of Fe(II) in synthetic ferrous sulfate solutions. Oxidation efficiencies of over 90% were attained within 14 to 35 days for aerated columns operating at room temperature with influent Fe(II) concentrations of 55 mM. The presence of mineral salts in the influent solution resulted in a shorter lag period before a steady state of iron oxidation was achieved. Chemical (abiotic) oxidation of Fe(II) was insignificant in the aerated columns, which were operated up to three months without a loss of activity.
W84-04230

A WATER HANDBOOK FOR METAL MINING OPERATIONS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
R. Wildeman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159755, Price codes: A05 in paper copy, A01 in microfiche. Colorado Water Resources Research Institute, Fort Collins, Completion Report No. 113, November, 1981. 84 p, 11 Fig, 4 Tab, 50 Ref, 2 Append. Project No. OWRT A-034-COLO (5), Contract/Grant No. 14-34-0001-6006.

Descriptors: Water quality control, *Mine drainage, Water analysis, *Metal mines, *Colorado, Front Range, Mining, *Chemical analysis, *Pollutant identification, Effluents, Weathering, *Water quality standards.

This is a handbook that operators of metal mines can use to understand how the various substances originate in mine water and what can be done to eliminate or control their occurrence. The introductory chapters review the chemical weathering reactions of rock forming and ore minerals, and the environmental standards that apply to drinking water and mining and milling effluents. Then there is a discussion of how various physical factors such as ore petrology, groundwater hydrology, and type of ore occurrence can affect the quality of mine drainages. This chapter is based on extensive investigations of mine drainages within the Front Range of Colorado. A plan for analysis of mine waters that emphasizes understanding the chemical nature of the water is established. Finally, suggestions for water maintenance are made based on the chemistry of the water and the analysis schedules. An appendix is a manual of common methods of analysis which emphasizes how to conduct successful tests in the environment of a mining operation.
W84-04233

DENITRIFICATION AS A MECHANISM FOR NITROGEN REMOVAL IN AEROBIC SYSTEMS: FEASIBILITY ANALYSIS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
A. J. McDonnell, S. E. Strand, and J. J. Warwick.
Available from the National Technical Information Service, Springfield, Va 22161 as PB84-159698, Price codes: A08 in paper copy, A01 in microfiche. PIRLWR, Completion Report (LW8402), The Pennsylvania State University, University Park, February, 1984. 153 p, 7 Fig, 4 Tab, 305 Ref, 2 Append. Project No. OWRT A-053-PA (1), Contract/Grant No. 14-34-0001-2140.

Descriptors: *Denitrification, *Nitrogen, *Nitrate, *Nitrogen removal, Sediments, Soils, Literature reviews, *Aerobic conditions, Dissolved oxygens, Nitrogen mass balance model.

Nitrogen losses from apparently aerobic aquatic systems have often been attributed to denitrification in anoxic microenvironments. An extensive literature review was made to evaluate the extent and magnitude of denitrification as it has been observed in aquatic ecosystems. Measurement of nitrogen loss in aquatic sediments are reviewed and factors that influence denitrification identified. A reconnaissance survey was made on the fate of nitrogen in a shallow, productive stream. Analysis, using a dissolved oxygen and nitrogen mass balance model in tandem, indicated significant nighttime in-stream denitrification derived nitrogen loss in the presence of dissolved oxygen concentrations of 2 to 3 mg/l. Results are considered too preliminary at the present time to draw substantive conclusions.
W84-04239

HYDROGEOLOGIC INVESTIGATION OF THE MAXEY FLATS RADIOACTIVE WASTE BURIAL SITE, FLEMING COUNTY, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
H. H. Zehner.
USGS Open-File Report 83-133, 1983. 148 p, 38 Fig, 30 Tab, 40 Ref.

Descriptors: *Radioactive waste disposal, *Groundwater pollution, *Groundwater movement, Hydrology, Geologic fractures, *Radiochemical analysis, Aquifer characteristics, Base flow, Transmissivity, Radioactive well logging, *Kentucky, Borden Formation, Sunbury Shale, Bedford Shale, Ohio Shale.

Burial trenches at the Maxey Flats radioactive waste burial site cover an area of about 20 acres, and are located on a plateau, about 300 to 400 feet above surrounding valleys. All waste is buried in the Nancy Member of the Borden Formation, and most is in the weathered shale (regolith) part of this member. Recharge to the rocks is probably by infiltration of rainfall through regolith at the top of the hill. At least two water tables are present: near the base of the regolith, at a depth of about 25 feet and; in the Ohio Shale, at a depth of about 300 feet. About 95 percent of ground-water discharge to streams is from colluvium on hillsides and valley alluvium. The remaining 5 percent is discharge from bedrock, of which about 0.5 percent is from rocks underlying the burial area. Waste radionuclides in the subsurface, other than tritium, were observed only in the regolith of the Nancy Member. Only tritium was observed with certainty in deeper rocks and in the adjacent valley alluvium. Other waste radionuclides were in streamwater and stream sediment, and may have been transported with overland runoff from the surface of the burial site. (USGS)
W84-04244

WATER-QUALITY ASSESSMENT OF WHITE RIVER BETWEEN LAKE SEQUOYAH AND BEAVER RESERVOIR, WASHINGTON COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 5C.
W84-04259

GROUNDWATER CONTAMINANT TRANSPORT MODELING,
Princeton Univ., NJ. Dept. of Civil Engineering.
G. F. Pinder.
Environmental Science and Technology, Vol. 18, NO. 4, p 108A-114A, April, 1984. 6 Fig, 8 Ref.

Descriptors: *Groundwater flow, *Solute transport, Model studies, Computers, Mathematical models, Equations, Groundwater pollution.

The use of groundwater transport modeling has seen enormous growth during the past 10 years. Current modeling efforts are very often motivated by a desire to simulate subsurface contaminant movement. Advanced computer technology has helped the groundwater model evolve from a scientific curiosity to an important and widely used engineering tool. Specific information is offered concerning groundwater flow, solute transport, numerical simulation, transport modeling, modeling strategy, field applications, and remedial strategies. (Baker-IVI)
W84-04289

DYNAMICS OF A FERTILIZER CONTAMINANT PLUME IN GROUNDWATER,
Illinois State Water Survey Div., Champaign.
M. J. Barcelona, and T. G. Naymik.
Environmental Science and Technology, Vol. 18, No. 4, p 257-261, April, 1984. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Groundwater pollution, *Fertilizers, Inorganic nitrogen, Mathematical model, Numerical solute transport model, Illinois.

A 2-year investigation has been conducted on the effects of a massive inorganic nitrogen fertilizer contamination of a sand and gravel aquifer in western Illinois. Groundwater monitoring in the early period of the project during near steady-state conditions disclosed that dissolved ammonium and nitrate levels exceeded 2000 and 13000 mg/L, respectively. A numerical solute transport model was applied to the system which predicted that approximately 420 days would be necessary after source removal to permit recovery of the aquifer water to near background levels within the study site. Subsequent monitoring results generally supported the model prediction and demonstrated its usefulness for predicting transport and transformations of inorganic forms of nitrogen. The chemistry and microbiology of the impact groundwater showed significant changes attendant to pollutant removal which indicate that microbially mediated processes occurred in the aquifer. (Author's abstract)
W84-04290

OCTACHLOROSTYRENE IN LAKE ONTARIO: SOURCES AND FATES,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Kaminsky, and R. A. Hites.
Environmental Science and Technology, Vol. 18, No. 4, p 275-279, April, 1984. 4 Fig, 1 Tab, 28 Ref. EPA grant 808961.

Descriptors: *Octachlorostyrene, *Lake Ontario, Water pollution sources, Fate of pollutants, Biological magnification, Chlorinated styrenes.

The presence of octachlorostyrene (OCS) in samples of fish from Lake Ontario has been particularly puzzling since this compound has never been a commercial product. The concentration of octachlorostyrene (OCS) was measured in dated segments of 11 sediment cores taken from Lake Ontario in order to establish the depositional history of this compound in the lake. OCS (as well as other chlorinated syrenes and chlorinated polycyclic aromatic hydrocarbons) originates primarily from the waste product of electrolytic chlorine production. This waste, called 'taffy', resulted from the chlorination of the tar or pitch used to bind graphite electrodes; its improper disposal led to the introduction of chlorinated aromatic compounds into the environment. OCS is present in all major sediment depositional areas of Lake Ontario and may be subject to biomagnification. Although OCS exhibited no toxicity or mutagenicity in a bacterial bioassay, the long-term environmental impact of chlorinated styrenes is still unknown. (Murphy-IVI)
W84-04291

BUTYLTIN COMPOUNDS AND INORGANIC TIN IN SEDIMENTS IN ONTARIO,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5A.
W84-04292

RADIUM AND BARIUM IN THE AMAZON RIVER SYSTEM,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 2K.
W84-04296

SALINITY AND WEATHERING RATE OF ROCKS IN A SEMI-ARID REGION,

Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
L. M. Moreira-Nordemann.
Journal of Hydrology, Vol. 71, No. 1-2, p 131-147, March 15, 1984. 4 Fig, 5 Tab, 39 Ref.

Descriptors: *Salinity, *Weathering rate, *Rocks, *Semiarid lands, Geochemistry, Total dissoved solids, Cations, Indicators, Uranium, Saline water systems, Salgado River, Brazil.

Rain- and river-water samples were collected for one year in the Salgado River basin, a semi-arid region in Bahia State, Brazil. Total dissolved solids (TDS) concentrations, and Na, Ca, K, Mg and U contents were measured in these samples and also in rock and soil samples of the basin. A geochemical balance and the chemical weathering rate of rocks were determined from these results. The water of Salgado River showed high concentrations of TDS (1.42 g/l) and cations; thus it was impossible to determine the chemical weathering rate of rocks by using these major cations as indicator elements. A rate of 36 t sq km/yr was obtained by using uranium as a natural tracer. Salgado River water belongs to the most abundant group of surface waters found in northeastern Brazil, that is, salty waters with high NaCl concentrations. (Author's abstract)
W84-04304

STREAM SALINITY IN THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India).
J. S. Choudhari, and K. D. Sharma.
Journal of Hydrology, Vol. 71, No. 1-2, p 149-163, March 15, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Salinity, *Streams, *India, *Arid zone, Rainfall-runoff relationships, Runoff volume, Chemical properties, Total dissolved solids, Magnesium, Potassium, Water quality.

Streams in the Indian desert are ephemeral in nature and carry water only in direct response to torrential rainfall. Streamwater quality was determined in the Indian desert for a period of three years, 1979-1981. Total dissolved salts (TDS) varied from 161 to 12,495 mg/l in various streams, depending upon the geology, landscape and volume of runoff. Highest concentrations of TDS were recorded at the onset of runoff in the initial flow event, followed by a rapid decrease in concentrations during the rising and recession flow stages. Sodium concentrations decreased with increasing discharge whereas calcium concentrations increased with discharge. Magnesium and potassium concentrations remained relatively uniform throughout the flow. TDS and individual ion concentrations displayed an annual fluctuation. Maximum concentration values were recorded following a flood year whereas minimum concentrations occur during the flood year. (Murphy-IVI)
W84-04305

NITRATE POLLUTION OF CHALK GROUNDWATER IN EAST YORKSHIRE - A DECADE ON,
Institute of Hydrology, Wallingford (England).
A. R. Lawrence, S. S. D. Foster, and P. W. Izzard.
Journal of the Institution of Water Engineers and Scientsts, Vol. 37, No. 5, p 410-420, October, 1983. 5 Fig, 1 Tab, 7 Ref.

Descriptors: *Groundwater contamination, *Nitrate, *Chalk aquifer, *East Yorkshire, *England, Water quality, Water pollution sources.

The records of nitrate concentration in two public groundwater supply sources in the Chalk aquifer of East Yorkshire during the 1970's are presented and interpreted with the aid of a program of unsaturated zone investigation. This program involved drilling 11 cored boreholes to allow the determination of porewater profiles for nitrate, ammonium, sulfate, chloride, calcium, sodium, and tritium, together with the measurement of matrix porosity and hydraulic conductivity. The current fluctuations in concentration of nitrate at a dip-slope source, such as Etton, are primarily a function of the proportion of arable land use in the groundwater catchment, the average unsaturated zone thickness and the borehole construction. The regime of groundwater quality fluctuations at an escarpment source, such as Market Weighton, is different, reflecting the greater importance of rapid unsaturated zone by-pass flow and saturated zone mixing. The rate and mode of downward migration of higher oncentrations through the unsaturated zone will be of importance in the precise prediction of future groundwater quality. The groundwater nitrate problem in East Yorkshire does not appear as severe as that in some of the drier areas of the Chalk outcrop, primarily, as a consequence of higher infiltration rates resulting in greater dilution of soil nitrate excess to crop requirements during the winter months, and secondarily of the somewhat higher proportion of non-arable land. (Baker-IVI)
W84-04309

PRELIMINARY ESTIMATES OF LOADS CARRIED BY RIVERS TO ESTUARIES AND COASTAL WATERS AROUND GREAT BRITAIN DERIVED FROM THE HARMONIZED MONITORING SCHEME,
J. C. Rodda, and G. N. Jones.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 529-538, December, 1983. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Estuaries, *Sediment transport, *Rivers, *Great Britain, Coastal waters, Land use, Water pollution sources, Industrial wastes, Sulfates, Nitrates, Zinc, Copper, Chloride, Orthophosphate, Cadmium, Lead.

Rivers carry a wide variety of materials in solution, in suspension, and by saltation. Some of this material originates from natural sources, the remainder is from sources dependent on man and his activities. Preliminary estimates are given of the loads of eight chemical determinands carried by the rivers draining Great Britain: chloride, nitrates, sulfate, orthophosphate, zinc, cadmium, lead, and copper. The loads of British rivers show considerable diversity, reflecting the relative abundance and heterogeneity of sources in the basins they drain. This diversity results from the wide variety of rock and soil types, together with the assortment of contrasting industrial, urban, and agricultural land use patterns which together create the distinctive scenery of the islands. Climate also causes natural variations of the flows of rivers to extend over four orders of magnitude. The distribution of sulfate loads is largely related to sources dependent on industry such as on mine drainage and on washout and deposition of atmospheric sulfur compounds emitted by thermal power stations. Uncertainties involved in the assessment of the loads of these determinands are noted. (Baker-IVI)
W84-04316

CHEMICAL AND TOXICITY ANALYSIS OF LEACHATES FROM COAL CONVERSION SOLID WASTES,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
R. D. Neufeld, and S. Wallach.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 266-273, March, 1984. 9 Fig, 5 Tab, 10 Ref. DOE contract DE-AC-18-79FC10061.

Descriptors: *Coal gasification, *Leaching, *Solid wastes, *Industrial wastes, *Fly ash, *Sludges, Sulfur, Metals, Toxicity, Path of pollutants, Daphnia.

Eight coal conversion solid wastes were used for this project: gasifier fly ash, bottom ash, sludges from the treatment of gasifier waste waters, and liquification bottoms materials. It proved impossible to stereotype coal conversion solid wastes as the waste depended on both the process and type of coal used. The fly ash materials were considerably smaller in particle size than the bottom materials. The ASTM-A procedure leached the least amount of metals, the EPA-EP an intermediate amount, and the PITT procedure the most materials. A summary of each of the three leaching procedures is offered. EPA-EP leachates from the wastewater lime sludge and alum sludge would not be considered hazardous under RCRA even through the total organic carbon concentrations exceeded 2500 mg/L and LC-50 values were very low. With the exception of the sludge leachates, none of the ASTM-A leachates exhibited acute Daphnia magna toxicity. All the EPA-EP leachates and the ASTM-A sludge leachates showed strong acute Daphnia magna toxicity. A log-log relationship was found between CL-50 data and the weighted sum of metals data for the EPA-EP leachates generated from the fly ash and all bottom solid wastes. A log-log relationship was found between LC-50 data and the phenol concentrations for the leachates generated from the lime and alum wastewater sludges. (Baker-IVI)
W84-04326

LEAD CYCLING IN ESTUARIES, ILLUSTRATED BY THE GIRONDE ESTUARY, FRANCE,
Ecole Normale Superieure, Paris (France). Lab. de Geologie.
F. Elbaz-Poulichet, P. Holliger, W. W. Huang, and J. M. Martin.
Nature, Vol. 308, No. 5958, p 409-414, March-April, 1984. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Lead cycling, *Estuaries, *Gironde estuary, *France, Physical properties, Recycling, Sediments, Turbidity, Lead, Water pollution sources, Fate of pollutants.

The cycling of lead in estuaries involves a complex exchange between dissolved and particulate phases. In macrotidal estuaries such as the Gironde (France), dissolved lead is absorbed onto particles due to an increase in turbidity and in the specific surface area of particles in the tidal estuary. In the lower estuary a mobilization of exchangeable and carbonate lead occurs simultaneously with a coagulation of organic dissolved lead associated with iron-manganese hydrous oxides. The lead-depleted particles are subsequently recycled to the tidal estuary by landward currents, where they become mixed with fresh river-borne particles. Lead isotopic ratios and particulate lead speciation studies indicate that in this estuary the mixing of polluted particles with old deposits probably has a minor role in the decrease in particulate lead. (Author's abstract)
W84-04338

NATURAL RADIOACTIVITY OF FRESH WATERS IN POLAND,
Central Lab. for Radiological Protection, Warsaw (Poland).
D. Grzybowska, T. Wardaszko, and J. Nidecka.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 309-318, 1983. 1 Fig, 6 Tab, 19 Ref.

Descriptors: *Radioactivity, *Fresh waters, *Poland, Deep waters, Well waters, Tap waters, Radium, Uranium, Thorium, Radon.

The natural radioactivity of waters is interpreted as the content of radioelements of all three radioactive series, irrespective of whether they originate from processes spontaneously proceeding in nature or from human activities. Concentration of natural radioelements: Ra-226, U, Th and Rn-222, in various kinds of fresh waters in Poland were determined. They were found to be near the lower limit of range of concentrations observed in other countries. The investigated waters differed in the Ra-226 content depending on their origin; when listed in order of decreasing Ra-226 concentration, these waters assumed the following sequence: deep waters > surface waters > well waters > tap waters. (Murphy-IVI)
W84-04339

DECLINE OF MERCURY IN YOUNG FISHES FROM WESTERN LAKE ERIE BETWEEN 1970-71 AND 1974,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
W. D. N. Busch.
Progressive Fish Culturist, Vol. 45, No. 4, p 202-206, October, 1983. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Mercury, *Fish, *Lake Erie, Methylmercury, Bioindicators, Shiner, Bass, Perch, Drum, Fate of pollutants.

Concentrations of total mercury were determined for samples of age 0-II whole fish of six species collected from western Lake Erie in 1970-71 and five species collected in 1974. Within years, average total mercury concentrations increased with age and size in all species. The concentrations were significantly lower (37 to 86%) in 1974 than in 1970-71. Methylmercury concentrations and the proportion of methylmercury to total mercury increased with age and size of fish in samples of four species collected in 1970-71. (Author's abstract)
W84-04343

ORGANIC CONTAMINANT BEHAVIOR DURING RAPID INFILTRATION OF SECONDARY WASTEWATER AT THE PHOENIX 23RD AVENUE PROJECT,
Stanford Univ., CA. Dept. of Civil Engineering.
E. J. Bouwer, P. L. McCarty, H. Bouwer, and R. C. Rice.
Water Research, Vol. 18, No. 4, p 463-472, 1984. 5 Fig, 8 Tab, 26 Ref.

Descriptors: *Fate of pollutants, *Rapid infiltration, *Groundwater recharge, *Organic compounds, *Phoenix, *Arizona, Water reuse, Wastewater renovation, Volatilization, Biodegradation, Sorption, Halogenated organic compounds, Aliphatic compounds, Aromatic compounds, Groundwater pollution.

Movement of trace organic pollutants during rapid infiltration of secondary wastewater for groundwater recharge was studied at the 23rd Avenue Rapid Infiltration Project in Phoenix, Arizona. Samples of the wastewater applied to the spreading basins and of renovated water taken from monitoring wells were characterized for priority pollutants and other specific organic compounds using gas chromatography/mass spectrometry. The concentrations of organic constituents were affected by volatilization, biodegradation and sorption process. Nonhalogenated aliphatics and aromatic hydrocarbons exhibited concentration decreases of 59-99 degrees, during soil percolation. Halogenated organic compounds were generally removed to a lesser extent. Concentrations of trichloroethylene, tetrachloroethylene, and pentachloroanisole appeared to be significantly higher in the renovated water than in the basin water, reasons for this behavior remain unclear. Many organic contaminants were detected in the groundwater indicating such systems should be designed to localize contamination of the aquifer. Chlorination of the wastewater had no significant effect on contamination and types of trace organic compounds. (Author's abstract)
W84-04353

SOME EXACT SOLUTIONS FOR SOLUTE TRANSPORT THROUGH SOILS CONTAINING LARGE CYLINDRICAL MACROPORES,
Agricultural Research Service, Riverside, CA. Salinity Lab.
For primary bibliographic entry see Field 2G.
W84-04358

AN ADVECTION-DIFFUSION CONCEPT FOR SOLUTE TRANSPORT IN HETEROGENEOUS UNCONSOLIDATED GEOLOGICAL DEPOSITS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2F.
W84-04361

A LAGRANGIAN POROUS MEDIA MASS TRANSPORT MODEL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
N. R. Thomson, J. F. Sykes, and W. C. Lennox.
Water Resources Research, Vol. 20, No. 3, p 391-399, March, 1984. 11 Fig, 2 Tab, 38 Ref.

Descriptors: *Path of pollutants, *Porous media, *Groundwater pollution, *Mass transport, Mathematical models, Groundwater movement, Advection, Dispersion.

The mathematical simulation of advective dispersive contaminant transport in groundwater involving large Peclet numbers is subject to numerical difficulties. For most numerical models the computational cost and computer core requirements escalate as the Peclet number increases. A two-dimensional Galerkin finite element model for flow and Lagrangian mass transport in porous media has been developed to alleviate numerical and computational difficulties. The solution methodology involves a linear triangular mesh which tracks along streamlines calculated from a flow equation having the stream function as the dependent variable. A comparsion of this model to Eulerian or fixed coordinate type models showed this model to be accurate and stable at a reduced computational effort. For an actual field contamination problem which contains large vertical concentration gradients, the simulated results compared with observed data. (Author's abstract)
W84-04363

POSSIBLE EVIDENCE FOR ENRICHMENT OF TRACE ELEMENTS IN THE HYDROUS MANGANESE OXIDE PHASES OF SUSPENDED MATTER FROM AN URBANIZED EMBAYMENT,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. A. Feely, G. J. Massoth, A. J. Paulson, and J. F. Gendron.
Estuarine, Coastal and Shelf Science, Vol. 17, No. 6, p 693-708, December, 1983. 10 Fig, 4 Tab, 48 Ref.

Descriptors: *Path of pollutants, *Bays, *Estuarine environment, *Trace elements, *Managanese oxide, *Duwamish River, *Elliot Bay, *Washington, Suspended solids, Particulates, Chromium, Nickel, Copper, Zinc, Lead, Heavy metals, Sediments, Heavy metals.

Near the mouths of many rivers, significant quantities of Mn are released from rapidly accumulating recent sediments and precipitate onto suspended matter in the overlying water. In the laboratory, freshly precipitated Mn oxide surfaces tend to readily sorb trace elements. Total and weak-acid-soluble trace elements in suspended matter from the Duwamish River and Elliott Bay, an urbanized estuary-embayment system in northwest Washington State, were determined from samples collected in February and September 1980. Mn scavenging in the water column is coincident with enrichments of Cr, Ni, Cu, Zn, and Pb in the suspended matter, suggesting a possible enrichment of these trace elements in a hydrous Mn oxide phase. The newly formed hydrous Mn oxides, which form coatings on the surfaces of fine particles in suspension, are to a significant degree exported from Elliot Bay. This process may be an important means for transporting trace elements from polluted estuaries and embayments to less polluted coastal and open-ocean environments. (Moore-IV)
W84-04369

EFFECTS OF AN OIL SPILL IN OUTDOOR MODEL TIDAL FLAT ECOSYSTEMS,
Hoffdgroep Maatschappelijke Technologie TNO, Den Helder (Netherlands). Vestiging Den Helder - Biologisch Veldwerk.
J. Kuiper, P. De Wilde, and W. Wolff.
Marine Pollution Bulletin, Vol. 15, No. 3, p 102-106, March, 1984. 6 Fig, 14 Ref.

Descriptors: *Oil spills, *Tidal waters, *Model studies, Ecosystems, North Sea, Tidal flats, Wadden Sea, Estuarine environment.

Oil Pollution Experiments (OPEX) are discussed which are designed to collect information on the possible effects of a spill threatening the tidal flats of the Wadden Sea, and to provide a basis for optimum treatment of such a spill. A one-year feasibility study was carried out with MOdel TIdal Flat ecosystems (MOTIFs), designed to represent tidal flat systems typical of the Wadden Sea and other temperate estuarine areas. During the first 6 months the 4 MOTIFs studied developed very similarly. After this period an oil spill was simulated by exposing two of the four MOTIFs to a floating oil mousse for one week. During this week part of the oil was buried in the sediment by bioturbation. This sediment-bound fraction caused a prolonged exposure of the MOTIFs to oil compounds. Short- and long-term effects resulted in large differences between oil-treated and control MOTIFs. These differences persisted to the end of the experiment, 7 months after the removal of most of the oil. (Baker-IVI)
W84-04395

DISSOLVED ORGANIC MATTER IN COASTAL WATERS AT JEDDAH, SAUDI ARABIA,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. M. El-Sayed.
Marine Pollution Bulletin, Vol. 15, No. 3, p 113-116, March, 1984. 1 Fig, 3 Tab, 11 Ref.

Descriptors: *Coastal waters, *Dissolved organic matter, Saudi Arabia, Jeddah, Red Sea, Water pollution effects, Wastewater pollution.

Water samples collected during April 1982-April 1983 from Red Sea coastal waters at Jeddah, Saudi Arabia, were investigated for dissolved organic carbon, dissolved organic nitrogen, dissolved lipid, dissolved organic phosphorus, dissolved monosaccharides, total dissolved sugars and dissolved polysaccharides. The variations in the observed dissolved matter distribution pattern are caused by its release by phytoplankton in the various stages of its growth, release from detrital materials and its pouring from exogenous sources like domestic wastes or other types of pollutants, and their utilization by heterotrophic organisms. Extremely high DOC values at two stations can be attributed to the direct effect of untreated wastes at those two locations. Since the consumption of oxygen is intimately linked to the oxidation of organic matter, in the presence of high concentrations of organic matter the consumption rate of oxygen will exceed that of its supply, leading to a reducing condition which favors the accumulation of excess organic matter. (Baker-IVI)
W84-04396

PURGEABLE ORGANICS IN TENNESSEE GROUNDWATERS: A PROBLEM ASSESSMENT,
Tennessee Univ., Knoxville. Coll. of Engineering.
R. Robinson, D. Reed, and R. L. Jones.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84169432, Price codes: A06 in paper copy, A01 in microfiche. Water Resources Research Center Report No. 99, December 1983. 6 Fig, 11 Tab, 58 Ref, 1 Append. Project No. OWRT A-065-Tenn(1), Contract/Grant No. 14-34-0001-0145.

Descriptors: *Tennessee, Groundwater, *Groundwater pollution, Water quality, *Path of pollutants, Trichloroethylene, Tetrachloroethylene, Methyl chloroform, Organic compounds, *Chlorinated hydrocarbons, Water pollution sources, Pollutant identification, Gas chromatography.

A study was conducted in Tennessee to determine if there is a problem with groundwater pollution by volatile organic compounds, specifically trichloroethylene (TCE), tetrachloroethylene (PCE), and methyl chloroform (MC). Groundwater samples were taken in Knox and Rutherford Counties and Davidson County wells near the Rutherford County border because of the favorable conditions. Samples were also taken in Blount, Cocke, Hamblen, Hawkins, Jefferson, Sevier, and Sullivan Counties at public water supplies using groundwater as a raw water source. There appear to be reasons for concern with groundwater contamination in Tennessee by volatile organic compounds. Industrialized urban and nearby surrounding areas are the places where groundwater contamination by TCE, PCE, and/or MC has and can be found. Of the 15 groundwater sources sampled and analyzed for TCE, PCE, and MC in industrial and

urban areas, 6 were found to contain 1 or more of he compounds at levels of 0.1 micrograms/l or nore (40 percent of the sources tested). None of hese compounds were found in groundwater from ural area sources above 0.1 micrograms/l.
W84-04412

BACTERIAL POLLUTION FROM AGRICULTURAL SOURCES: A REVIEW,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
S. R. Crane, J. A. Moore, M. E. Grismer, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 858-866, 872, May-June, 1983. 5 Tab, 82 Ref.

Descriptors: *Bacteria, *Agriculture, *Water pollution sources, *Livestock, Reviews, Animal wastes, Agricultural runoff, Vegetation, Surface waters, Bioindicators, Infiltration, Leaching.

The extent of bacterial contamination of surface and ground waters associated with animal production units and waste application areas seems largely to depend on the production and waste management practices used by individual livestock operations. Management practices must be developed and proven both technologically and economically feasible which will reduce to a small percentage the indicator and pathogenic bacteria lost from these sites. Even with implementation of the best management practices, the indicator bacterial densities in runoff will probably range from 1000 to 100,000 organisms/100 mL as has been shown previously to be the base or background level from agriculturally oriented land use areas. Specifics are offered concerning the determination of the quantity of bacteria transported from animal waste application sites, recommended practices to reduce health risks, management practices to minimize bacterial losses, application time and use of storage facilities, and site selection criteria for waste application sites and livestock operations. (Baker-IVI)
W84-04446

EROSION OF SOIL AND POULTRY MANURE A LABORATORY STUDY,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
P. W. Westerman, T. L. Donnelly, and M. R. Overcash.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1070-1078 and 1084, July-August, 1983. 1 Fig, 12 Tab, 45 Ref.

Descriptors: *Manure, *Soil erosion, *Path of pollutants, Water pollution sources, Farm wastes, Land application, Rainfall intensity, Sediment transport, Loading rate, Waste disposal.

Land application of livestock and poultry manures on bare soil can result in high availability of nutrients for transport in surface runoff which may result in pollution of streams, rivers and lakes. Farmers often wait several days after manure application before they incorporate the manure. The transport of soil and manure by simulated rainfall on 1 m x 0.64 m laboratory test plots was investigated to determine the effects of rainfall intensity, soil type, manure type, loading rate and drying time. A factorial experimental design was used with each factor at two levels. Rainfall intensity and soil type were significant factors for solids transport, and manure loading rate was a significant factor for nutrient transport. Loading rain strongly influenced volatile solids, manure soilds and nutrient transport. Manure type and drying time were also significant factors for transport of certain nutrients. Increased drying time reduced manure and soil transport. Several factors and their interactions had significant effects on erosion and transport of soil, manure and nutrients. Prediction models of erosion and nutrient transport from areas receiving manure should consider several factors, including manure type, manure loading rate, and time between application and rainfall. (Moore-IVI)
W84-04450

RUNOFF LOSSES OF NUTRIENTS AND SOIL FROM GROUND FALL-FERTILIZED AFTER SOYBEAN HARVEST,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. L. Baker, and J. M. Laflen.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1122-1127, July, August, 1983. 6 Tab, 13 Fig.

Descriptors: *Fertilizers, *Nutrients, *Water pollution sources, *Agricultural runoff, *Soil erosion, Soybeans, Tillage, Point-injection, Water quality control.

Plot measurements of soil and nutrient runoff concentrations and losses were made for two simulated rains in the fall after soybean harvest and fertilization (N, P, and K at 31, 35, and 80 kg/ha, respectively). The five treatments were: fertilizer surface-applied, no incorporation; fertilizer point-injected into the soil; fertilizer incorporated by chisel plowing; fertilizer incorporated by disking; and no fertilizer applied, no tillage. Chisel plowing reduced surface residue coverage from 82% (before tillage and the first rain) to 48%; disking reduced coverage to 31%. About half the residue buried by tillage was uncovered by the first rain. Sediment concentrations in runoff from the tillage plots were about three times higher than from the no-tillage plots. For rain 1 (111 mm), loosening the soil by tillage reduced runoff amounts, particularly from the chisel-plow treatment; for rain 2(72 mm), runoff from the disked treatment was about three times that from the other treatments. Total soil loss from the disk treatments was 2.3 T/ha, which was at least three times higher than any other treatment. Concentrations of NH4-N, PO4-P, and K in runoff water and on sediment from treatments where fertilizer was incorporated by either point-injection or tillage were at the same levels as from the unfertilized treatment. Chemical concentrations from the surface-application-without-incorporation treatment were significantly higher than from all other treatments, particularly for the first rain (e.g., NH4-N greater than 3 mg/L, PO4-P greater than 0.9 mg/L, and K greater than 18 mg/L). Total NH4-N, PO4-P, and K losses were also the greatest for the surface-applications-without-incorporation treatment, but were only 0.8, 0.4, and 5.9 kg/ha, respectively. On the basis of these results, fall fertilization would not be recommended because of water quality concerns. If fertilizer is applied, no tillage should be performed because of the potential for increased soil losses; but if tillage is performed, chisel plowing would be preferred to disking. When point-injection of liquid fertilizers becomes feasible on a large scale, its advantage of nutrient incorporation without residue incorporation will warrant its recommendation. (Author's abstract)
W84-04457

COMPARISON OF RUNOFF QUALITY FROM CATTLE FEEDING ON WINTER PASTURES,
Idaho Univ., Moscow.
J. E. Dixon, G. R. Stephenson, A. J. Lingg, D. V. Naylor, and D. D. Hinman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1146-1149, July-August, 1983. 5 Tab, 7 Ref.

Descriptors: *Pastures, *Cattle, *Hay, *Water pollution sources, Idaho, Irrigation-return flow, Alfalfa, Grasses, Water pollution control, Filter crops.

Most cow-calf ranchers in the rocky Mountain Region confine their cattle during the winter and graze them from late spring to early fall. During the grazing season, most of the confinement areas are irrigated and used to produce alfalfa or mixed species hay. The loss of ten chemical, two bacteriological, and four other constituents from cow-calf wintering areas in Owyhee County, Idaho was quantified. Three hay crops were examined for their potential to filter the pollutants from the holding area runoff. Three hay crops (ground cover) treatments with two replications were established using a mixture of alfalfa with one of three grasses: brome, fescue, and orchardgrass. Cattle were placed on plots each winter and removed each spring for three years. The plots were irrigated twice each year. Irrigation and runoff flows were monitored and water samples taken for analysis. An analysis of variance showed no significant difference between the ground cover treatment means for any constituent, although there was a trend toward better pollutant retention with the alfalfa-fescue mixture. The amount of constituent loss through irrigation return flow from land wintering cattle seems to be small. (Moore-IVI)
W84-04460

ERODIBILITY OF SELECTED RECLAIMED SURFACE MINED SOILS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
J. K. Mitchell, W. C. Moldenhauer, and D. D. Gustavson.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1413-1421, September-October, 1983. 4 Tab, 13 Ref.

Descriptors: *Soil erosion, *Land reclamation, *Strip mines, Water pollution sources, Surface runoff, Storm runoff, Soil conservation, Sediments.

The contribution of erosion from reclaimed surface mined land to sediment pollution of surface waters was evaluated. Rainulator test sites were established on three sites, representing different soil types. Unmined sites refer to those that were not disturbed by mining operations although they had been under cultivation; whereas reclaimed refers to land that has been mined and the topsoil replaced. The plots received simulated rainfall of 64 mm/h, consisting of an initial rainulator runoff 60 min followed about one hour later by two 30 min runs on the wet soil. Soil losses per EI unit and calculated erodibilties from the initial storms (dry runs) were generally lower than those resulting from subsequent storms (wet and very wet runs). Mean soil erodibilities for the respective runs were generally greater on the unmined sites than those calculated for the reclaimed sites. An average annual soil erodibility factor was calculated by using the formula developed for the soil erodibility nomograph to place the observed values more nearly on an annual basis. These values appeared well suited for use in the Universal Soil Loss Equation on reclaimed surface mined lands for computing average annual soil losses or designing conservation practices. The estimates of the average annual soil erodibility factor for the reclaimed sites were 74% of the corresponding unmined estimates on the average. (Baker-IVI)
W84-04467

COMPARISON OF SIMULATED AND MEASURED NITRATE LOSSES IN TILE EFFLUENT,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, H. P. Johnson, and J. L. Baker.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1451-1457, September-October, 1983. 8 Fig, 3 Tab, 28 Ref.

Descriptors: *Nitrates, *Tile drainage, *Simulation, Fertilizers, Water pollution sources, Computer models, Hydrologic models, Effluents.

The current agricultural practice of making a single application of nitrogen fertilizer to meet the demands of the crop for the entire year may result in nitrogen leaving the system through leaching, wash-off and volitilization or staying in the soil for possible later use. Nitrogen leached out of the root zone may reduce the quality of groundwater or surface water. A hydrologic and nitrate-transport simulation model was developed and used to simulate the major water and nitrogen-transport processes occurring in a typical agricultural watershed during the crop growth period. Data from a tile drainage experiment were used to evaluate the simulation model. The model predictions agreed reasonably well with the measured values of tile drainage water and nitrate losses in the tile effluent. The difference between measured and predicted values indicates that the hydrology of the area is not completely understood in the present form of model or that some of the soil moisture properties estimated do not reflect the actual field conditions.

Measured as well as predicted data indicate that an equivalent of nearly half of the applied fertilizer nitrogen is being discharged with tile drainage water. (Moore-IVI)
W84-04472

INFLUENCE OF LIVESTOCK ON NONPOINT SOURCE NUTRIENT LEVELS OF STREAMS,
Tennessee Valley Authority, Knoxville.
A. M. Duda, and D. S. Finan.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1710-1716, November-December, 1983. 6 Fig, 5 Tab, 19 Ref.

Descriptors: *Livestock, *Nonpoint pollution sources, *Nutrients, *North Carolina, Drainage, Forest watersheds, Nitrogen, Phosphorus, Animal wastes, Storm runoff.

Ten agricultural watersheds with widely varying populations of livestock were instrumented to collect samples of lowflow and storm-event nutrient concentrations. Conducted in the Piedmont and Coastal Plain of North Carolina, the investigation demonstrated that much higher concentrations of nutrients occur in watersheds with extensive artificial drainage and larger nonpoint source populations of livestock than in similar agricultural watersheds with low populations of livestock. In addition, comparisons were made with nutrient levels previously recorded in forested watersheds in North Carolina. For total phosphorus, agricultural watersheds without high populations of livestock had mean concentrations 5 to 10 fold greater than mostly forested watersheds, while those with high populations of livestock approached 50 fold increases. For total inorganic nitrogen, the increases over forested watersheds approached 100 fold for agricultural watersheds with high populations of livestock. Observations are made concerning the production of stormflow from variable source areas in the watershed and the significance of animal waste and agricultural drainage improvements in causing elevated levels of nutrients in coastal waters. (Author's abstract)
W84-04479

NITRATE CONTENT OF GROUND WATERS IN AGRICULTURAL AREAS OF THE OKA RIVER BASIN,
V. N. Bashkin, and V. N. Kudeyarov.
Soviet Soil Science, Vol. 15, No. 1, p 41-47, 1983. 5 Fig, 11 Ref. Translated from Agrokhimiya, No. 2, p 14-19, 1983.

Descriptors: *Water pollution sources, *Groundwater pollution, *Nitrates, *Oka River Basin, *USSR, Statistical analysis, Gorodnyanka River, Skniga River, Itska River, Sokhna River, Oka River, Farming, Fertilizers, Animal wastes.

A significant but non-linear correlation between the nitrate content of ground waters and the application of nitrogen containing mineral fertilizers, total mineral and organic fertilizer nitrogen and cattle populations has been established in four agricultural areas. The areas were small rivers basins, Gorodnyanka, Skniga, Itska, and Sokhnam, each a tributary of the Oka with a total area of about 866 sq km. The areas differed only in their proportion of agricultural lands, the amounts of mineral and organic fertilizers applied, and cattle populations. The average nitrate nitrogen content varied by area and time of observation, ranging from 44 to 10 mg/liter, and tended to increase during the winter compared with the previous summer. (Baker-IVI)
W84-04517

MOVEMENT OF ALDICARB IN DIFFERENT SOIL TYPES,
California Univ., Davis. Dept. of Environmental Toxicology.
T. M. Awad, W. W. Kilgore, and W. Winterlin.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 377-382. April, 1984. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Pesticides, Aldicarb, Groundwater pollution, Pesticide residues, Soil properties, Soil types, Clay, Loam, Sand, Leaching.

The movement of aldicarb was studied in different soil types under lab conditions and the effects of large volumes of water on this movement was also investigated. Thirty-five grams of 8 different but well defined soils were packed in individual glass columns and tapped lightly. Twenty-five mg of aldicarb active ingredient in formulated form were added to the top of the column and mixed thoroughly with the top inch of soil. Three aliquots of 50 mL each of distilled water were then added to the top of the soil columns. Soil types included sand, loam, clay, sandy-loam, clay-loam, silt-loam, muck, and peat. Clay soil retained the highest amount of aldicarb residues followed by loam soil. The apparent retention of aldicarb residues by loam and clay soils may be a function of water flow as well as some type of physical binding to the soil particles. The lowest amounts of aldicarb residues were found in sandy, sandy-loam and peat soils. (Baker-IVI)
W84-04542

2,3,6-TRICHLOROPHENYLACETIC ACID (FENAC) DEGRADATION IN AQUEOUS AND SOIL SYSTEMS,
State Univ. of New York Coll. of Environmental Science and Forestry, Syracuse. School of Landscape Architecture.
A. Rosenberg.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 383-390, April, 1984. 3 Fig, 15 Ref.

Descriptors: *Fate of pollutants, *Herbicides, *Biodegradation, *Trichlorophenylacetic acid, *Fenac, Sewage, Wastewater, Lake water, Soil water, Nutrients, Microorganisms.

The environmental fate of 2,3,6-trichlorophenylacetic acid was examined by studying its biodegradation and product formation in sewage, lake water, soil and soil suspensions. Metabolism of fenac was first determined by using lake water and the primary effluent of municipal sewage. Degradation was followed by GLC and HPLC of extracted aliquots of the mixtures in the flasks. In the nutrient-supplemented lake water, degradation was evident within one month and reached nearly 25% of the initial concentration of fenac after three months, while less than 7% of the initial fenac was degraded after 3 months in the unsupplemented water. In contrast, unsupplemented sewage had as much activity as supplemented lake water while supplemented sewage showed the loss of fenac within 1 week and after 3 months nearly 40% of the compound has been degraded. Less than 2% of the chemical was lost in sterile samples of lake water and sewage. Fenac was degraded, albeit slowly in certain systems, and this degradation is dependent on high cell densities and the ecosystem used. Herbicides with a chlorine in the meta position are generally resistant to microbial degradation and apparently transformation of fenac to an aromatically intact metabolite is easier than ring cleavage. (Baker-IVI)
W84-04543

MOBILIZATION OF AZAARENES FROM WASTEWATER TREATMENT PLANT BIOSLUDGE,
Oak Ridge National Lab., TN. Environmental Sciences Div.
G. R. Southworth, and J. L. Keller.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 445-452, April, 1984. 2 Fig, 2 Tab, 16 Ref.

Descriptors: *Landfills, *Sludge disposal, *Water pollution sources, *Azaarenes, Wastewater treatment, Aromatic compounds, Quinoline, Acridine, Benz(a)acridine, Dibenz(a,h)acridine, Leaching, Path of pollutants, Partition coefficients.

The possible presence of azaarenes in residues disposed of in landfills represents a potential source of groundwater contamination. The partitioning behavior of a homologous series of azaarenes was examined between water and a wastewater sludge under conditions representing both neutral and cationic species of the aromatic bases. Large differences in sorption were observed among the four compounds: quinoline, acridine, benz(a)acridine, and dibenz(a,h)acridine. The partitioning of azaarenes between organic rich sludge and water appears to be dominated by the mechanism of hydrophobic partitioning. Low molecular weight azaarenes (2-3 rings) are readily leached from organic rich sludge, while under acidic conditions the mobilization of larger compounds becomes more significant. The large amount of lime and ferric chloride used to stabilize and flocculate the sludge would ensure the presence of alkaline conditions initially upon disposal. Leaching of the inorganic bases and generation of carbon dioxide and organic acids as the sludge degrades could act to promote the eventual establishment of a low pH environment within a disposal site. The mobility of azaarenes outside the disposal site will be determined in part by the sorption of the compounds by soil receiving the leachate from a disposal site. (Baker-IVI)
W84-04546

SPILL OF METHYL PARATHION IN THE MEDITERRANEAN SEA: A CASE STUDY AT PORT-SAID, EGYPT,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. I. Badawy, M. A. El-Dib, and O. A. Aly.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 469-477, April, 1984. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Methyl parathion, *Port-Said, *Egypt, *Mediterranean Sea, Fate of Pollutants, Fish, Sediments, Water analysis, Insecticides, Spills.

More than 1000 kg of methyl parathion entered the Mediterranean Sea as a result of a collision of two ships in February of 1982, near the north entrance of the Suez Canal at Port-Said. The concentration of methyl parathion in sediments, fish samples, and sea water taken from the area is reported. The follow up of the distribution of methyl parathion concentration at the various sampling sites indicated that the prevailing meteorological conditions have an influence in drifting the spilled insecticide towards the south-west direction. Uptake of methyl parathion was subject to variation according to fish species concerned, time of exposure and the concentration of insecticide in water. (Baker-IVI)
W84-04548

A BACTERIOLOGICAL ASSESSMENT OF THE MERSEY ESTUARY AND NORTH WIRRAL COAST, UK,
Stockport Metropolitan Borough Council, Chester (England). Environmental Health Dept.
E. J. Dillon, and B. Henderson-Sellers.
Water, Air, and Soil Pollution, Vol. 22, No. 3, p 241-255, April, 1984. 4 Fig, 1 Tab, 13 Ref.

Descriptors: *Bacteria, *Estuaries, *River Mersey, *North Wirral Coast, *England, Bioindicators, Water pollution sources, Industrial wastes, Municipal wastewater, Escherichia, Coliforms, Salmonella.

The River Mersey and its Estuary are assessed for the effects of pollution by use of biological indicators. A sampling program for certain bacteria indicates that there is often gross pollution, athough there is a wide range of observed values on both short time and space scales. This study considers bacteriological contamination in order to supplement existing survey data on heavy metals, dissolved oxygen, biochemical oxygen demand and suspended solids. The upper section of the estuary receives considerable quantities of sewage effluent and industrial waste. The initial sampling program was designed to investigate the incidence of total coliforms, Escherichia coli, Salmonella, and antibiotic resistant bacteria. Sludge dumping in Liverpool Bay has had only insignficant effects on coliform levels studied here. The tidal Mersey receives 39 crude industrial discharges, 54 crude water authority discharges as well as the effluent from industry and sewage works via tributaries and the Manchester Ship Canal. Samples from the estuary

showed high readings of E. coli. The contribution of E. coli and salmonella organisms from shipboard sewage is very difficult to assess. (Baker-IVI)
W84-04561

METAL COMPOSITION OF SOIL SEDIMENTS, AND URBAN DUST AND DIRT SAMPLES FROM THE MENOMONEE RIVER WATERSHED, WISCONSIN,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. Dong, G. Chesters, and G. V. Simsiman.
Water, Air and Soil Pollution, Vol. 22, No, 3, p 257-275, April, 1984. 2 Fig, 8 Tab, 17 Ref. Environmental Agency Grant R005142.

Descriptors: *Metals, *Soil, *Sediments, *Urban dust, *Menomonee River Watershed, *Wisconsin, Menomonee River, Path of pollutants, Fate of pollutants, Particle size, Particle shape, Vehicular emission, Chemical properties, Bottom sediments.

The Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn contents of the sand, silt, and clay fractions were determined for soils, urban street dust and bottom- and suspended-sediments sampled in the Menomonee River watershed, Wisconsin. The samples were dispersed by ultrasound prior to fractionation. The ultrasound dispersion avoids chemical contamination or alteration resulting from use of chemical dispersants and insures the dispersion of aggregates present in mechanically-sieved samples. Chemical analyses of fractionated samples were more precise than analyses of unfractionated samples in identifying areas in the watershed receiving pollutant inputs. Higher levels of Cr, Cu, Fe, and Ni were found in the coarser particles than in the finer particles of urban street dust samples. The Cd, Pb, and Zn contents of some bottom and suspended sediments were greater than in the soils of the watershed. Contents of these metals were correlated significantly with each other in the clay-sized fraction of sediments but not in soils. The metal contents of sediments were largely controlled by vehicular emission. (Author's abstract)
W84-04562

RETENTION AND RELEASE OF CHEMICAL SPECIES BY A NORTHERN MICHIGAN SNOWPACK,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
S. H. Cadle, J. M. Dasch, and N. E. Grossnickle.
Water, Air and Soil Pollution, Vol. 22, No. 3, p 303-319, April, 1984. 7 Fig, 7 Tab, 10 Ref.

Descriptors: *Snowpack, *Chemical properties, *Michigan, Snowmelt, Hydrogen ion concentration, Water pollution sources, Acidic water, Cations, Anions, Ions, Snow sampling, Runoff, Little Pigeon River, McNearney Lake.

The rapid release of acids from snowpack during the spring thaw can cause a temporary drop in the pH of poorly buffered lakes and streams. Snowcore and water samples were collected during the 1981 to 82 winter at two independent sites in Northern Michigan; the Little Pigeon River and McNearney Lake. Acidic and basic species were determined in all samples. Examination of the concentration vs depth profiles of snow cores showed that all species were stable in the snowpack until the spring thaw period. During the thaw, 50 to 70% of the stored acids were released during the first 20% of the snowmelt. However, rainfall during the melt period contributed as much acidity to the environment as the snowmelt. The runoff showed that only 30% of the nitrate originally present in the snowpack appeared in the Little Pigeon River. Therefore, H2SO4 dominated the runoff acidity at the Little Pigeon River. Both nitrate and sulfate were responsible for the slight acidification of McNearney Lake during the snowmelt period. (Murphy-IVI)
W84-04564

DESCRIBING THE TRANSPORT OF ION-EXCHANING CONTAMINANTS USING AN EFFECTIVE KD APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
A. J. Valocchi.
Water Resources Research, Vol. 20, No. 4, p 499-503, April, 1984. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Ion exchange, *Distribution coefficient, *Solute transport, Mathematical equations, Groundwater pollution, Water pollution sources, Fate of pollutants, Simulation model.

The fate of many inorganic and organic contaminants in groundwater systems is strongly influenced by ion exchange and sorption reactions. Hydrogeologists have traditionally used distribution coefficients Kd to describe the rate of migration of sorbing contaminants. Recent investigations have questioned the validity of the Kd approach for contaminants governed by multicomponent ion exchange and have noted that computed Kd values in such cases are not constant across an advancing solute front. This report demonstrates that mass balance arguments can nevertheless be utilized to define a constant 'effective' Kd which may then be used to calculate the contaminant front velocity. For selected cases of one-dimensional binary and ternary exchange, front locations calculated using the effective Kd approach is also applied to a field problem involving the injection of advanced-treated municipal effluent into a shallow confined aquifer. Although the effective Kd approach is sometimes a practically useful tool, it is shown to be limited to situations where dispersion can be neglected. (Murphy-IVI)
W84-04574

EFFECT OF CROPPING, SUMMERFALLOW AND FERTILIZER NITROGEN ON NITRATE-NITROGEN LOST BY LEACHING ON A BROWN CHERNOZEMIC LOAM,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
C. A. Campbell, R. DeJong, and R. P. Zentner.
Canadian Journal of Soil Science, Vol. 64, No. 1, p 61-74, February, 1984. 5 Fig, 5 Tab, 22 Ref.

Descriptors: *Environmental effects, *Cropping, *Summerfallow, *Fertilization, *Nitrogen, *Leaching, *Brown Chernozemic loam, Soil organic matter, Soil porosity, Soil properties.

In 1982, six crop rotation treatments that were initiated in 1967 on a Orthic Brown Chernozemic loam were sampled for soil NO3-N and moisture to a depth of 240 cm. Soil samples were taken on 18 May and 10 June from all treatments, on 2 Sept. on fallow treatments only, and on 14 Oct. from cropped treatments. Precipitation during the sampling period was about 23% above the long-term average. It was estimated that at least 123 kg NO3-N/ha were leached from the top 240 cm of fallow soils. Leaching appeared to result from a portion of the precipitation moving through macro soil pores. There was evidence that water and NO3-N might also move upwards from below the 240-cm depth. Of the six rotations examined, the 2-yr and 3-yr spring wheat (Triticum aestivum L.) rotations lost the most NO3-N. The presence of fall rye (Secale cereate L.) in a fallow-rye-wheat rotation was very effective in reducing NO3-N losses. Spring wheat, when grown continuously, was also very effective in reducing NO3-N losses but even here there was some evidence of leaching beyond the root zone. Application of fertilizer N and P at amounts based on soil test recommendations reduced NO3-N leached. It was estimated from long-term precipitation data, that over the past 100 yr about 20% of the soil organic N that was present at the time of breaking the land has been lost from the soil via leaching. It was concluded that leaching losses of N from the soils on the Canadian prairies had been greatly underestimated and were partly responsible for losses attributed to the more visible wind erosion. (Author's abstract)
W84-04577

A NEW APPROACH TO PREDICTING THE DISPERSION OF A CONTINUOUS POLLUTANT SOURCE (UNE NOUVELLE DEMARCHE POUR LA PREDICTION DE LA DISPERSION D'UNE SOURCE DE POLLUTION CONTINUE),
Canterbury Univ., Christchurch (New Zealand).
A. J. McNulty, and I. R. Wood.
Journal of Hydraulic Research, Vol. 22, No. 1, p 23-34, 1984. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Path of pollutants, *Model studies, Dispersion, Rivers, Predicting, Estimating, Mixing, Nonuniform flow, Turbulence.

In order to assess the potential impact of the release of a pollutant in a river, it is necessary to determine the pollutant concentration downstream of the release point. A new approach to diffusion of a continuous source has enabled non-uniform conditions to be modelled. As a first step towards a better understanding of the mixing from a continuous source, this study considers a continuous line source in a wide channel. An algorithm has been developed to obtain the complete downstream concentration distribution for any turbulent shear flow. This enables the more realistic logarithmic velocity and parabolic diffusivity distributions to be used. The results are compared with those obtained using assumptions that the longitudinal concentration gradients are negligible and that the velocity and diffusivity are both constant over the depth. (Baker-IVI)
W84-04588

TRANSVERSE MIXING IN OPEN CHANNEL FLOW,
Karlsruhe Water Resources Agency (Germany, F.R.).
G. Webel, and M. Schatzmann.
Journal of Hydraulic Engineering, Vol. 110, No. 4, p 423-435, April, 1984. 7 Fig, 1 Tab, 22 Ref.

Descriptors: *Tranverse mixing, *Open-channel flow, Rectangular open-channel flow, Smooth open-channel flow, Rough open-channel flow, Cooling water, Plumes, Mathematical models, Hydrodynamics.

The prediction of cooling water or wastewater dispersion in rivers requires an accurate treatment of the far field region of the plume. An experimental study motivated by dimensional analysis was carried out to investigate the variation in the transverse mixing coefficient in straight, rectangular, smooth, and rough open channel flows. The findings have led to a number of suggestions relating to the future laboratory simulations of prototype cooling-water or wastewater dispersion in a river. The mixing coefficient is essentially a 'catch-all' parameter lumping together the combined effects of turbulent diffusion, secondary flow, and dispersion due to nonuniformity of the transverse velocity profile. Turbulent diffusion is by far the major contributor to this coefficient. The increase in the tranverse mixing coefficient can be explained by the fact that in hydraulically smooth turbulent flows, the scale of the energy containing eddies is larger than in hydraulically rough but otherwise identical open channel flows. Recognizing that the basic transport mechanism for pollutant dispersal in rivers is turbulent diffusion, model/prototype-similarity requires an undistorted model to ensure that large eddies be represented in a geometrically similar manner between field and laboratory; and the same friction factor to be maintained to assure that similar amounts of energy are supplied from the time-mean flow into the underlying turbulent system. (Murphy-IVI)
W84-04590

SNAIL MARISA CORNUARIETIS IN TROPICAL HYDROELECTRIC RESERVOIRS,
World Health Organization, New York. Blue Nile Project in Sudan.
For primary bibliographic entry see Field 2H.
W84-04596

SALT EFFLORESCENCE IN PRICE RIVER BASIN,
New Mexico Water Resources, Santa Fe.
B. K. Rao, D. S. Bowles, and R. J. Wagenet.
Journal of Environmental Engineering, Vol. 110, No. 2, p 457-471, April, 1984. 6 Fig, 2 Tab, 27 Ref. OWRT project B-172-Utah, grant 14-34-0001-9099.

Descriptors: *Salt efflorescence, *Price River basin, Saline water intrusion, Salinity, Saline soils, Water pollution sources, Fate of pollutants.

Salt efflorescence has been hypothesized to be an important nonpoint source of salinity in the Price River basin which is a major salt contributor, relative to its contribution of water, to the Colorado River system. Efflorescent salt loading was investigated through field studies, aerial photography, laboratory experiments, and mathematical modeling. The conditions favorable to the formation of salt efflorescence crusts are highly saline soil water near the soil surface and a source of heat above the soil for evaporating the soil water. Field data indicate that the salt efflorescence crust forms over the first 10-15 days after a storm runoff washes off the earlier efflorescence. After this period, the efflorescence crust apparently acts as a physical barrier to further soil water evaporation. Observation from aerial photography suggest that the major source of salt for efflorescence is the water that infiltrates saline geological formations and returns to ephemeral streams with dissolved salts. An expected value of salt efflorescence crust density at the time of a storm was computed by fitting an exponential probability distribution for the time interval between consecutive summer storms in the Price River basin. This density, which was estimated as 1.40 kg/sq m, was used with an average number of four storms per year and the fraction of the total basin area underlain by marine Mancos shale to obtain the estimate that salt efflorescence contributes approximately 8.5% of the total salt loading in the Price River basin. It was assumed that all the salt efflorescence crust is washed off during each storm, and that no salt is leached back into the soil. Therefore, the foregoing percentage may be expected to be an upper bound estimate. Also, it neglects efflorescent salt loading outside the summer season. This study adds to the previous studies in the Price River basin in concluding that the surface salt sources produce a relatively small fraction of the total loading. This conclusion suggests that subsurface sources of salt pickup are significant and future salt loading studies in the basin should consider subsurface processes. (Murphy-IVI)
W84-04600

NUTRIENT CYCLING IN AN AGRICULTURAL WATERSHED: II. STREAMFLOW AND ARTIFICIAL DRAINAGE,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. L. Todd, and L. E. Asmussen.
Journal of Environmental Quality, Vol. 13, No. 1, p 27-32, January-March, 1984. 4 Fig, 2 Tab, 23 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Agricultural watersheds, *Streamflow, *Drainage water, *Nutrient cycling, Water pollution sources, Nitrogen, Phosphorus, Calcium, Potassium, Chloride, Sulfates, Seasonal variation, Sediment load.

Streamflow is an important means of nutrient export off most watersheds. In agricultural areas, effluent from artificial drainage can be an important contribution to streamflow nutrient loads. The objective of this study was to examine seasonal variations of nutrients in streamflow and to quantify the effects of artificial drainage effluent on streamflow nuturients on an agricultural watershed. Concentrations and loads of NO3-N, NH4-N, organic N, dissolved molybdate-reactive P, total P, Ca, Mg, K, Cl, and SO4-S were measured in streamflow and artificial drainflow on a 1568-ha agricultural watershed near Tifton, Ga. All 10 streamflow sampling sites had maximum NO3-N and SO4-S concentrations in winter and most reached minima during summer. Concentrations of NO3-N, Ca, Mg, Km and Cl were generally much higher in drainage water than streamflow. Load of NO3-N from drained row-crop fields was about 40.4 kg/ha/y, 60 times the per-hectare NO3-N load from the mixed cover watershed. Loads of organic N, Ca, Mg, K, SO4-S, and Cl from the mixed cover watershed were 2.8, 9.3, 4.5, 6.5, 17.0, and 30.0 kg/ha/y, respectively. Loads (per hectare) of organic N were lower from the drained fields, but loads of Ca, Mg, K, SO4-S, and Cl were from the mixed cover watershed. In-stream and riparian zone processes apparently converted inorganic N to organic forms and removed N through denitrification. Annual streamflow N load was about 29% of the precipitation input of 12.2 kg/ha/y. Sediment-associated N and P loads in streamflow were 0.35 and 0.09 kg/ha/y, respectively, accounting for 9.0 and 8.5% of total N and P, respectively. The two highest flow events for the year carried 19% of the total annual flow and 19% of the annual sediment load, but had 30 and 27% of the total annual sediment N and P loads, respectively. This enrichment of sediment-associated N and P indicated that part of this sediment load moved directly from upland areas. (Author's abstract)
W84-04602

A TURBULENT-TRANSPORT MODEL FOR CONCENTRATION FLUCTUATIONS AND FLUXES,
Aeronautical Research Associates of Princeton, Inc., NJ.
R. I. Sykes, W. S. Lewellen, and S. F. Parker.
Journal of Fluid Mechanics, Vol. 139, p 193-218, 1984. 12 Fig, 31 Ref, 1 Append.

Descriptors: *Turbulent flow, *Model studies, Plumes, Sediment transport, Path of pollutants, Mathematical equations.

Most of the more fundamental theoretical methods present very severe problems in their extension to non-homogenous or time-dependent turbulent fields, so that some intermediate is required. The second-order closure framework provides such a level, in that more of the physical processes are contained within the equations than with eddy-diffusivity models, but the equations are still considerably simpler than a spectral closure. A second-order closure model describing the diffusion of a passive scalar from a small source is presented. The model improves upon earlier ones in that attention has been paid to the early stages of the release to ensure that correct behavior is modelled. The model as presented predicts the linear and parabolic regimes of the mean-concentration profile growth without any new empirical constraints, and compares well with experimental data. The main restriction is that each release must be treated separately. Any requirement from the specification of time-dependent diffusivities has been removed by allowing all the turbulence correlations to diffuse at the same rate as the mean concentration in the early stages. This closes the system of equations, allowing the closure model to completely determine the solution in terms of the background turbulence parameters. The new model also contains an equation for the evolution of the scalar variance. (Baker-IVI)
W84-04603

HEAVY METAL DISPERSION PATTERNS FROM TAILINGS DUMPS, NORTHAMPTON DISTRICT, WESTERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Floreat Park (Australia). Div. of Mineralogy.
A. W. Mann, and M. Lintern.
Environmental Pollution (Series B), Vol. 6, No. 1, p 33-49, 1983. 7 Fig, 4 Tab, 7 Ref.

Descriptors: *Heavy metals, *Drainage systems, *Northampton, *Australia, *Mine wastes, Leaching, Water pollution sources, Fate of pollutants, Chapman River, Bowes River, Murchison River, Western Australia.

Dispersion of heavy metals into drainage systems of the Chapman, Bowes and Murchison Rivers occurs as a result of sediment transport and leaching from tailings dumps in the Northamptom Mineral District, Western Australia. Anomalous heavy metal values occur in stream sediments up to 20 km from their source. Lead shows the most widespread distribution and concentrations in excess of 1000 microg/liter Pb occur in stream waters close to contaminant sources. Development of acidity is restricted because of the high pH (7.0-9.0) of natural groundwaters in the region, and the predominance of sulphides of lead and zinc over those containing iron. (Author's abstract)
W84-04616

HEAVY METAL BURDEN IN WATER, SUBSTRATE, AND MACROINVERTEBRATE BODY TISSUE OF A POLLUTED RIVER IRWELL (ENGLAND),
Brock Univ., St. Catharines (Ontario). Dept. of Biological Sciences.
S. S. Dixit, and D. Witcomb.
Environmental Pollution (Series B), Vol. 6, No. 3, p 161-172, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Heavy metals, *Fate of pollutants, *Water quality, *Substrates, *Macroinvertebrates, *Tissue analysis, Asellus, Erpobdella, Oligochaetes, Chironomids, Bioindicators, Bioaccumulation.

The River Irwell macroinvertebrate fauna is suffering from heavy metal pollution. Atomic absorption spectrophotometry shows high levels of zinc, copper, and lead in the substrate matter and the invertebrates (Asellus, Erpobdella, oligochaetes and chironomids). A linear relationship exists between the substrate heavy metal levels and that of invertebrates. Oligochaetes and chironomids show highest levels of metal accumulations, while Erpobdella and Asellus accumulate moderate to low levels of metals in their bodies. In invertebrates, the metal accumulation rates are dependent on their mode of association with the substrate and their physiological ability to excrete the metals. In comparison with substrate matter and invertebrates, the river water contains low metal levels. This is most probably due to the slightly alkaline (pH 7-6) nature of the river which precipitates an increased load of metals. (Author's abstract)
W84-04619

OBSERVATIONS ON HEAVY METAL GEOCHEMICAL ASSOCIATIONS IN POLLUTED AND NON-POLLUTED ESTUARINE SEDIMENTS,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. A. Badri, and S. R. Aston.
Environmental Pollution (Series B), Vol. 6, No. 3, p 181-193, 1983. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Heavy metals, *Geochemistry, *Estuaries, *Sediments, Chemical composition, Nonlithogenous fractions.

The total concentrations and the geochemical associations in surface sediments from three estuaries in northwest England have been studied. The estuaries represent varying degrees of pollution, and the present results indicate rather different behavior among the metals and the sites investigated. The distribution of the metals in the 'easily or freely leachable and exchangeable', 'oxidizable-organic', 'reducible' and 'resistant' fractions of the sediments were determined by a sequential leaching technique. For all metals, the resistant fraction was dominant, especially for iron. Among the other (non-lithogenous) fractions the oxidizable organic fraction was frequently important. (Author's abstract)
W84-04620

ARSENIC, GOLD AND MERCURY CONCENTRATION LEVELS IN FRESHWATER FISH BY NEUTRON ACTIVATION ANALYSIS,
Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W84-04621

FATE OF PENTACHLOROPHENOL IN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, R. P. Gambrell, and K. S. Reddy.
Environmental Pollution (Series B), Vol. 6, No. 4, p 297-308, 1983. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Fate of pollutants, *Pentachlorophenol, *Estuaries, *Sediments, Hydrogen ion concentration, Oxidation-reduction potential, Degradation, Chemical degradation, Louisiana, Coastal waters, Shell Beach.

The fate of pentachlorophenol (PCP) following a major spill in a Louisiana Gulf Coast estuary was examined. Degradation of PCP was strongly influenced by sediment pH and oxidation-reduction potential conditions. Degradation rates decreased with decreasing sediment oxidation-reduction potential. Maximum degradation occurred at pH 8.0. Adsorption/desorption studies show PCP to be more tightly bound to oxidized sediment than to reduced sediment. The measured degradation rates suggest that microbial degradation could account for the observed disappearance of residual PCP in the spill area. (Author's abstract)
W84-04622

FATE AND DISTRIBUTION OF THE MOTHPROOFING AGENTS DIELDRIN AND EULAN WA NEW IN LOCH LEVEN, KINROSS, 1964-1979,
Freshwater Fisheries Lab., Pitlochry (Scotland).
D. E. Wells, and A. A. Cowan.
Environmental Pollution (Series B), Vol. 7, No. 1, p 11-33, 1984. 4 Fig, 7 Tab, 14 Ref.

Descriptors: *Fate of pollutants, *Dieldrin, *Eulan WA New, *Loch Leven, *Kinross, Bioaccumulation, Sediment, Pesticides, Scotland.

Following the cessation of the use of dieldrin in 1963 and the subsequent use of Eulan WA New at the textile mill in Kinross, Scotland, the fate and distribution of the mothproofing agents in the Loch Leven environment were studied. Fish samples analyzed between 1963 and 1970 showed a decline in dieldrin concentrations with a half-life of 0.56-0.82 years (r greater than 0.87). Samples of water, sediment, zooplankton and fish were taken for analysis during 1978-1979. About 50% of the Eulan WA New remained in the soluble ionic form and was discharged into the River Leven. Much of the remaining 50% was associated with particulate matter and sediment. Less than 10% was associated with the biota. The samples were analyzed using GC-ECD and GC-MS-DS with decachlorobiphenyl as the internal standard. (Author's abstract)
W84-04623

NITROGEN FERTILISATION AND NITRATE POLLUTION OF GROUNDWATER IN SANDY SOILS,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
M. K. Yusop, O. Van Cleemput, and L. Baert.
Environmental Pollution (Series B), Vol. 7, No. 1, p 43-48, 1984. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Nitrogen, *Fertilization, *Groundwater pollution, *Sandy soils, Infiltration, Nitrates, Denitrification, Leaching, Belgium.

The study of the relation between N fertilization and groundwater pollution was carried out on two fields in the sandy area of Belgium during a two-year period. The fields under study were grown with maize and barely and received fertilizer N and manure at normally applied rates. The NO3(-)-N and Cl(-) content of the groundwater at 0.5, 1.0, 1.5 and 2.0 m depth was monitored every two weeks. The total rainfall during the two consecutive years was about 800 mm. On one of the fields, the NO3(-)-N content at all depths was mostly above 11.3 mg NO3(-)-N d/cu m, the WHO safe limit. However, on the other field the nitrate level was much lower, except at 0.5 m depth. The difference between the two fields was attributed to differences in the rate of N input. The fluctuations during the two-year study were influenced by N fertilization and rainfall distribution. The NO3(-)-N/Cl(-) ratio indicated that denitrification in the deeper zones of the soil was not prominent. (Author's abstract)
W84-04624

FLUORIDE RETENTION IN HIGHLY LEACHED DISTURBED SOILS,
Newcastle Univ. (Australia). Dept. of Biological Sciences.
F. Murray.
Environmental Pollution (Series B), Vol. 7, No. 1, p 83-95, 1984. 2 Fig, 5 Tab, 28 Ref.

Descriptors: *Flouride, *Retention, *Leaching, *Disturbed soil, Soil structure, Iron, Aluminum, Soil physical properties, Soil chemistry.

The fluoride retention capacity of highly leached disturbed soil, possessing little soil structure, was examined by applying fluoride to soil cores in cylinders and subjecting them to leaching for 12 months. Even at very high fluoride application rates only 2.6 to 4.6% of the fluoride applied was leached as water-soluble fluoride. The pH of the eluate increased with increasing mass of fluoride applied to the columns, probably as a result of fluoride adsorption by exchange with OH(-) from soil metal hydroxides. During the course of the experiment the water-soluble fluoride content of the soils decreased due to an enhancement of the firmness of the link between the surfaces of soil particles and fluoride, which occurs with time. Both water-soluble and total fluoride concentrations were found to be greatest at a depth of 0.7 to 1.4 m. It was concluded that soil iron and aluminum compounds may be the major fluoride retention factors in this soil, although other soil physical and chemical factors may also be involved. These reconstituted soils possess a very high capacity to retain fluoride despite their high permeability and relative absence of structure. (Author's abstract)
W84-04626

CESIUM-137, METALS AND ORGANIC CARBON IN THE SEDIMENTS OF THE JAMES RIVER ESTUARY, VIRGINIA,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. T. F. Wong, and C. S. Moy.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 37-49, January, 1984. 4 Fig, 4 Tab, 43 Ref. NOAA grant NA-80-FA-D-0007.

Descriptors: *Cesium-137, *Copper, *Lead, *Zinc, *Organic carbon, *Sediments, James River estuary, Subenvironments, Metals, Radioactive tracers, Radioactive dating, James River, Virginia.

A wide variety of sedimentary subenvironments are found within a 10-km stretch of James River including a flood dominated channel (Rocklanding Channel) and its bank (Rocklanding Shoal), a shoal with a water depth of 1 m separating two channels (Point of Shoals), an ebb-dominated channel (Burwell Bay Channel) and its bank (Burwell Bay Bank) and a tributary (Warwick River). The concentrations of Cs-137, Cu, Pb, Zn and organic carbon in the fine-grained sediments (i.e. less than 63 microm) and the amount of fine-grained sediments in eight cores covering these subenvironments were determined. The sedimentation rates, estimated by Cs-137 geochronology, range from 0.4 to greater than 3 cm/year. The sedimentation rates in the Burwell Bay region are two or more times those in the Point of Shoals and in the Rocklanding Channel and Shoal, reflecting the weaker currents in the Burwell Bay region. These sedimentation rates agree well with those obtained independently by measuring changes in the bathymetry of this area between 1873 and 1943. The concentrations of Cs-137, Cu, Pb, Zn and organic carbon in surface sediments vary by a factor of two to three. The concentrations are higher in the Burwell Bay region, probably as a result of the higher rates of accumulation of recently formed sediments in these subenvironments. The inventories of fine-grained sediments and of Cs-137, Cu, Pb, Zn and organic carbon accumulated since 1954 are also up to an order of magnitude higher in the Burwell Bay region. Although the concentrations of fine-grained sediments in three cores obtained in this region are similar, the inventories still vary by a factor of two to three. The inventories of Cs-137, Cu, Pb, Zn, organic carbon and fine-grained sediments correlate well with each other indicating that Cs-137 can be a useful tracer for studying the fate of these metals and organic carbon in estuarine environments. The inhomogeneity of the concentrations and inventories of the different elements along a 10-km segment of a river suggests that a closely-spaced sampling program is essential for characterizing the sedimentary provinces within an estuary. The concentrations of Cs-137, metals and organic carbon in the coarse-grained sediments (i.e. greater than 63 microm) are considerably lower than those in fine-grained sediments. Thus, the contribution of coarse-grained sediments to the total inventory of these elements is small. (Author's abstract)
W84-04630

TOTAL SELENIUM AND SELENIUM (IV) IN THE JAMES RIVER ESTUARY AND SOUTHERN CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
K. Takayanagi, and G. T. F. Wong.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 113-119, January, 1984. 5 Fig, 38 Ref.

Descriptors: *Selenium, *James River estuary, *Chesapeake Bay, James River, Salinity, Chemical properties, Mixing, Geochemistry.

The concentrations of total selenium (Se) and Se (IV) were determined in the surface waters of 30 stations located in the James River and southern Chesapeake Bay. The concentrations of total Se and Se (IV) ranged from 0.28 to 1.91 nM and from 0.07 to 1.36 nM, respectively, between salinities of 31.78 and 0.06 0/00. The concentration of Se (VI), calculated as the difference between the concentrations of total Se and Se (IV), ranged from 0.08 to 0.67 nM. While total Se seemed to be conservative in this study area at salinities above 0.36 0/00, Se (IV) might have been removed during estuarine mixing. The removal of Se (IV) occurred primarily at salinities below 4 0/00 possibly via the oxidation of Se (IV) to Se (VI). (Author's abstract)
W84-04632

POLYCHLORINATED BIPHENYLS (PCBS) IN THE MARINE ENVIRONMENT, PARTICULARLY IN THE MEDITERRANEAN,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Okologische Chemie.
H. Geyer, D. Freitag, and F. Korte.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 129-151, April, 1984. 1 Fig, 17 Tab, 109 Ref.

Descriptors: *Polychlorinated biphenyls, *Marine environment, *Mediterranean, Bioaccumulation, Sediments, Microplankton, Algae, Mussels, Fish, Marine organisms, Sea birds, Water pollution.

Polychlorinated biphenyls (PCBs) possess a low water solubility, a high n-octanol/water partition coefficient, and a high persistence, particularly those which are highly chlorinated. Because of these properties they are bioaccumulated in many organisms in the environment. PCBs are still manufactured industrially and used in the Mediterranean countries (e.g., Italy, Spain, and France). The concentrations of PCBs in marine air, water, sediments, microplankton, algae, mussels, fish and other marine organisms including seabirds from the Mediterranean area are reviewed and compared with PCB concentrations in marine samples from non-Mediterranean regions. Levels of PCBs in seawater are highest in the western and central Mediterranean. The data for mussels and fish give a clear indication that the PCB levels are higher in the Northwest and the Tyrrhenian Sea than in the eastern Mediterranean. The FDA in June 1979 set 2 mg/kg as the temporary maximum concentrations for PCBs in fish and shellfish. The PCB residues in some fish from the northwestern Mediterranean and Tyrrhenian Sea and in some mussels from the Adriatic Sea are higher than this limit. The amount of PCBs ingested via food by the Mediterranean population is unknown. (Murphy-IVI)
W84-04637

FATE OF ANTHRACENE IN AN ARTIFICIAL STREAM: A CASE STUDY,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
P. F. Landrum, S. M. Bartell, J. P. Giesy, G. J. Leversee, and J. W. Bowling.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 183-201, April, 1984. 3 Fig, 8 Tab, 23 Ref. Department of Energy contract DOE-AC09-76SR00819.

Descriptors: *Fate of pollutants, *Anthracene, *Artificial stream, *Polycyclic aromatic hydrocarbons, Water pollution effects, Degradation, Sinks, Toxicity, Hydrocarbons, Model studies.

The fate of anthracene, a representative polycyclic aromatic hydrocarbon, was followed in a large outdoor stream microcosm. The major nonadvective route for the removal of anthracene was photolytic degradation to anthraquinone (half-life 43 min). The anthraquinone also photolyzed rapidly in this shallow stream system. Excluding the plastic channel liner, the sediment acts as the major sink for anthracene, absorbing 0.2% of the 14-day input dose. The periphyton community was the second most important sink, absorbing 0.04% of the input dose. All other compartments were of significantly less importance on a mass basis. Anthracene (11 microg/liter) caused photoinduced 100% mortality of the bluegill sunfish in 9 hr in the upstream reach. Fish at the downstream station survived for approximately 26 hr and all died within 1 hr of each other. Other organisms, clams and dragonfly larvae, started to die off toward the end of the 14-day input period. (Author's abstract)
W84-04638

A GENERAL STOCHASTIC MODEL FOR PREDICTING BOD AND DO IN STREAMS,
North Carolina Univ. at Charlotte. Dept. of Mathematics.
S. D. Damaskos, and A. S. Papadopoulos.
International Journal of Environmental Studies, Vol. 21, No. 3/4, p 229-237, October, 1983. 7 Fig, 10 Ref.

Descriptors: *Stochastic process, *Biochemical oxygen demand, Dissolved oxygen, Streams, Predicting, Forecasting, Oxygen, Sedimentation, Absorption, Path of pollutants, Model studies.

The stochastic model presented in this study is a random differential equation. The solution process is discussed. An example and computation are given indicating how the results may be used to study the statistical properties of the biochemical oxygen demand (BOD) and dissolved oxygen (DO) processes at any point down the stream from a source of pollution. It is assumed that there are five major activities in the stream: the pollution and dissolved oxygen are decreased by bacterial action; the dissolved oxygen is increased due to the process of reaeration at a rate proportional to the DO deficit; the BOD is only decreased by sedimentation and absorption at a rate proportional to the amount of pollution present; the pollution is increased from small sources along the stretches of stream; and the DO is decreased at a given rate in ppm per day. (Baker-IVI)
W84-04657

THE ABUNDANCE OF AU, PT, PD, AND THE MODE OF HEAVY METAL FIXATION IN HIGHLY POLLUTED SEDIMENTS FROM THE RHINE RIVER NEAR MAINZ, WEST GERMANY,
Mainz Univ. (Germany, F.R.).
C. B. Dissanayake, K. Kritsotakis, and H. J. Tobschall.
International Journal of Environmental Studies, Vol. 22, No. 2, p 109-119, January, 1984. 4 Fig, 3 Tab, 28 Ref. Deutsche Forschungsgemeinschaft grant 53/11.

Descriptors: *Heavy metals, *Pollutants, *Sediments, *Rhine River, *Mainz, *West Germany, *Gold, *Lead, *Platinum, *Ginsheimer-Altrhine River, Fate of pollutants, Industrial wastes, Water pollution, Pollution load.

The Au, Pt, and Pd contents of the sediments of Ginsheimer-Altrhine River, a channel of the Rhine river which drains one of the most industrialized regions of western Europe, have been determined by flameless atomic absorption spectrophotometry. The abundances of these noble metals range from 96-460 ppb Au; 734 ppb-31 ppm Pt and 32 ppb-4 ppm Pd. The extremely high concentrations, particularly those of Pt and Pd, are attributed to their use in industry and are due to the formation and concentration of metal-organic complexes, mainly at the interface between an extremely reducing and an oxidizing aquatic environment. Differential thermal analyses of the polluted sediments in comparison to the pure humic acid and Fe-humate complex show that humic and fulvic acids are of great importance in the transport of heavy metals in polluted stream sediments. (Author's abstract)
W84-04662

A NON-EQUILIBRIUM APPROACH TO MODELING METAL SPECIATION IN ACID, AQUATIC SYSTEMS: THEORY AND PROCESS EQUATIONS,
Savannah River Ecology Lab., Aiken, SC.
T. D. Fontaine, III.
Ecological Modelling, Vol. 21, No. 4, p 287-313, March, 1984. 10 Fig, 5 Tab, 43 Ref. Department of Energy contract DE-AC09-76SR00819.

Descriptors: *Mathematical equations, *Algorithms, *Metals, *Aquatic environment, Chemical speciation, Speciation, Heavy metals, Ion exchange.

A general algorithm (NONEQUI) was developed to simulate reversible sorption and ion exchange kinetics among a variety of heavy metals and substrates in acid (pH less than 6.5) lake or stream environments. Competitive metal-substrate and substrate-substrate interactions are modeled as kinetic processes rather than invoking an instantaneous equilibrium assumption. This distinction from other models offers certain advantages when attempting to predict the fate, speciation, transport and ultimately biological effects of toxic metals in dynamic media such as lakes and streams. (Author's abstract)
W84-04676

INPUT-OUTPUT BUDGETS AT LANGTJERN, A SMALL ACIDIFIED LAKE IN SOUTHERN NORWAY,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W84-04695

DILUTION AND ACIDIFICATION EFFECTS DURING THE SPRING FLOOD OF FOUR SWEDISH MOUNTAIN BROOKS,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 2E.
W84-04697

TRACE METALS IN SWEDISH NATURAL FRESH WATERS,
National Swedish Environment Protection Board, Solna.
H. Borg.
Hydrobiologia, Vol. 101, No. 1/2, p 27-34, April, 1983. 9 Fig, 4 Tab, 10 Ref.

Descriptors: *Trace metals, *Sweden, *Natural water, Hydrogen ion concentration, Acidity, Cadmium, Lead, Aluminum, Manganese, Zinc, Comparison studies, Humic substances, Water color.

Water samples were collected from unpolluted waters in southern and northern Sweden to show the range of natural trace metal concentrations. The results do not indicate any significant differences in metal levels between the two study areas. Negative correlations with pH exist for total concentrations of Cd, Pb, Al, Mn and Zn. The dissolved (dialysable) metal fractions also increase with increasing acidity. The concentration of humic substances influences the distribution of Fe, Mn, Al, Pb, Cr, Co and As, as shown by positive correlations with water color. Increasing alkalinity has a limiting effect upon concentrations and annual fluctuations of Cd, and Pb, and to some extent on Zn, in running waters. (Author's abstract)
W84-04698

ORIGIN AND PRODUCTION OF PHOSPHATASES IN THE ACID LAKE GARDSJON,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
H. Olsson.
Hydrobiologia, Vol. 101, No. 1/2, p 49-58, April, 1983. 8 Fig, 2 Tab, 10 Ref.

Descriptors: *Phosphorus compounds, *Acidic lakes, *Gardsjon Lake, *Acid water, Phosphatases, Hydrogen ion concentration, Chemical properties, Forest hydrology.

The activity of acid phosphatases was followed for one year in Lake Gardsjon as well as in the inlet and the outlet of the lake. A budget of the phosphatases was calculated, including an estimation of the production of phosphatases. The phosphatase activity was also measured in two basins upstream of L. Gardsjon: the north basin and the south basin of L. Stora Hastevatten. The acid phosphatase activity was very high compared with reported alkaline phosphatase activities in other lakes. About 95% of the phosphatases in L. Gardsjon was produced in the lake, and the production was highest in early summer. Small Chrysophyceae (< 10 microm) probably produced the majority of the acid phosphatases in the investigated lakes, and accordingly could be favored in environments with low phosphorus supply due to their ability to produce large amounts of phosphatases. (Author's abstract)
W84-04700

HEAVY METAL INDICATOR POTENTIAL OF THE ASIATIC CLAM (CORBICULA FLUMINEA) IN ARTIFICIAL STREAM SYSTEMS,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. L. Graney, Jr., D. S. Cherry, and J. Cairns, Jr.
Hydrobiologia, Vol. 102, No. 2, p 81-88, June, 1983. 1 Fig, 2 Tab, 28 Ref. Department of Energy contract E-(40-1)-4939.

Descriptors: *Heavy metals, *Asiatic clam, *Corficula, *Artificial streams, *Bioindicators, Bioaccumulation, Cadmium, Copper, Zinc.

The potential of the Asiatic clam, Corbicula fluminea, as a bioindicator of cadmium, copper, and zinc was studied during 28-day exposures in field artificial streams, receiving river water on a once-through basis. Copper, at aquatic concentrations of 0.016 and 0.057 mg/l, showed the greatest degree of tissue uptake and had bioconcentration factors (BCF) of 22,571 and 17,720, respectively. A significant correlation (coefficient = 0.639) was observed between water concentration and tissue accumulation. Cadmium was intermediate relative to BCF (3,770 and 1,752 at aquatic exposures of 0.023 and 0.055 mg/l, respectively), and had a correlation coefficient of 0.758. Zinc had the lowest potential for concentration (631, 358, and 511 BCF at 0.218, 0.433, and 0.835 mg/l, respectively) with a correlation coefficient of 0.478. The rate of accumulation in Corbicula reached a maximum after 11 days of cadmium while a steady state condition for copper was not observed in 28 days. Zinc accumulation, like copper, showed a relative increase throughout the 28-day exposure period. Data from this study show that the Asiatic clam may be a reliable indicator of uptake for exposure to selected heavy metals. (Author's abstract)
W84-04717

A COMPARISON OF STREAMS IN LOGGED AND UNLOGGED AREAS OF GREAT SMOKY MOUNTAINS NATIONAL PARK,
National Park Service, Omaha, NE. Midwest Region.
D. G. Silsbee, and G. L. Larson.

Hydrobiologia, Vol. 102, No. 2, p 99-111, June, 1983. 3 Fig, 11 Tab, 27 Ref.

Descriptors: *Logging, *Comparison studies, *Great Smoky Mountains National Park, Water quality, Benthic macroinvertebrates, Detritus, Debris dams, Debris basins, Macroinvertebrates, Benthos.

Second order streams draining areas of virgin forest in Great Smoky Mountains National Park, Tennessee and North Carolina, U.S.A., are compared to those which drain forests logged before the establishment of the park in the 1930's. Water quality of two main study streams (one unlogged and one formerly logged) was compared and the unlogged stream had generally higher levels of dissolved solids and lower levels of suspended particulates than the logged stream. Stream channel characteristics were compared on four logged and four unlogged streams. The unlogged streams had over four times more (by volume) of woody debris and 10 times more material in debris dams than the logged streams. Only minor differences in substrate composition were observed. Macroinvertebrate samples from the four logged and four unlogged streams showed that the logged streams contained greater numbers of organisms and more taxa. More detailed sampling on the two main study streams showed similar patterns of more individuals and more taxa in the logged stream, as well as differences in the composition of five functional groups. These differences in invertebrate fauna may be due to differences in quantity and quality of leaf litter inputs, although other explanations are also possible. (Author's abstract)
W84-04719

EFFECT OF RETURN WATER FROM IRRIGATED RICE FIELDS ON THE SALINITY OF WATER IN THE KILIA BRANCH OF THE DANUBE,
Central Research Inst. on the Multipurpose Use of Water Resources, Kiev (USSR).
R. G. Zadorozhnaya.
Hydrobiological Journal, Vol. 19, No. 2, p 69-75, 1983. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Water pollution sources, *Salinity, *Irrigation-return flow, *Danube river, Water use, Irrigation, Mixing, Rice, Salinity, Seasonal variation.

The dilution of the saline return waters from the Kilia and Liski irrigated rice areas and the salinity of the diluted water before its intake into the Liski and Vilkovo municipal water systems were determined. The width of the water-mixing band is calculated. The low dilution of the winter return waters from the rice fields, and especially of summer return waters above Liski and Vilkova Town is due to the fact that only a part of the Danube water participates in the dilution process. The dilution of the summer return waters from the Kilia Rice Irrigation System (RIS) above Liski involves only 14% and that of winter return waters only 34% of the total water flow in the Solomon arm of the Danube. The corresponding values at Vilkovo are 31 and 62% of the total flow in the Kilia arm. The salinity of Danube water during the vegetative and cold periods increases, but only in the mixing band. The discharge of return water from the Kilia and Liski RIS in the direct vicinity of Liski and Vilkova is undesirable. (Baker-IVI)
W84-04727

COMPLEXING OF METAL IONS IN NATURAL WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Hydrobiologia, Vol. 19, No. 3, p 71-85, 1983. 1 Fig, 4 Tab, 92 Ref.

Descriptors: *Complexing, *Metals, *Ions, *Natural waters, *Literature review, Organic compounds, Chemical properties, Mathematical equations, Humic substances, Inorganic compounds.

In recent years exhaustive sutdies have been undertaken to determine the state of metal ions in natural waters, including theri complexing. The results are extremely important both in scientific explanation of the physiological effect of metals on aquatic organisms and in the solution of a number of practical problems. Some of which concern the development of effective measures for the removal of metals from potable and industrial waters, the development of hydrochemical techniques of search for minerals, prediction of the chemical composition of natural waters polluted by industrial and agricultural effluents. A review of the literature on complexing of metal ions in natural waters is presented. Complexing properties of compounds most characteristic of natural waters, and the mechanisms of metal ion binding to form complexes are discussed, as are various techniques for studying complexing. Stability constant logarithms are given for complexes of metals with humic substances and other organic compounds of natural origin. Complexing affects a large fraction of metals present in natural water, enhancing their mobility and their ability to migrate in solution. Fresh water metal complexes were predominately humic substances, whereas seawater metal complexes were predominately inorganic forms. (Murphy-IVI)
W84-04734

COMPLEXATION OF COPPER BY AQUATIC HUMIC SUBSTANCES FROM DIFFERENT ENVIRONMENTS,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2K.
W84-04740

ACCUMULATION OF CADMIUM BY ABARENICOLA PACIFICA,
Oregon State Univ., Corvallis. Dept. of Civil Engineering.
S. M. Oakley, K. J. Williamson, and P. O. Nelson.
The Science of the Total Environment, Vol. 28, p 105-118, June, 1983. 8 Fig, 2 Tab, 35 Ref.

Descriptors: *Cadmium, *Bioaccumulation, *Abarenicola, Trace metals, Bioavailability, Geochemistry, Kinetic models, Sediments, Seawater, Path of pollutants.

The bioavailability of trace metals to marine organisms depends on trace metal partitioning among geochemical phases and on the kinetics of uptake from each phase. This study was undertaken to develop a kinetic model for trace metal uptake based on equilibrium partitioning of the metal in aqueous and sedimentary phases. A three compartment model was developed and used to estimate the accumulation of cadmium under short term laboratory conditions. The rate of cadmium uptake from bentonite clay, humic acid, ferric hydroxide, and seawater was measured for the deposit-feeding polychaete Abarenicola pacifica. The results show that, under the conditions of this study, bentonite clay and ferric hydroxide can be more important sources of cadmium than seawater for Abarenicola pacifica. (Author's abstract)
W84-04743

FATES OF METAL RADIOTRACERS ADDED TO A WHOLE LAKE: ACCUMULATION IN SLIMY SCULPIN (COTTUS COGNATUS) AND WHITE SUCKER (CATOSTOMUS COMMERSONI),
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. F. Klaverkamp, M. A. Turner, S. E. Harrison, and R. H. Hesslein.
The Science of the Total Environment, Vol. 28, p 119-128, June, 1983. 5 Fig, 4 Tab, 13 Ref. NSF grant OCE 75-15105.

Descriptors: *Radioisotopes, *Radioactive tracers, *Bioaccumulation, Fate of pollutants, Sculpin, Sucker, Radioactive wastes, Iron radioisotopes, Zinc radioisotopes, Selenium radioisotopes, Cesiium radioisotopes, Mercury radioisotopes.

The gamma-emitting isotopes, iron-59, cobalt-60, zinc-65, selenium-75, cesium-134 and mercury-203, were added in mid-summer to Lake 224 of the Experimental Lakes Area in northwestern Ontario. This experiment was part of a larger program of limnological investigations on radioisotopes of heavy metals present in industrial and nuclear power effluents. Isotope activities in whole bodies of slimy sculpins and in blood, gills, gut contents, kidney, liver and spleen of white suckers were determined for periods up to 247 days after isotope addition. Results demonstrate delay between contamination of a lake and transfer of contaminant to these fish species. General relationships between movement and distribution of isotopes in water and their accumulation in these fish indicate that direct accumulation from water is not a major route of uptake. Direct evidence supporting food as the major route of uptake is lacking, because feeding behavior of these species was not studied and gut contents were not analyzed to identify biological organisms. (Moore-IVI)
W84-04744

MIGRATION OF RADIOCONTAMINANTS IN A FORESTED WETLAND ON THE CANADIAN SHIELD: NUCLIDE SPECIATION AND ARBOREAL UPTAKE,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
E. L. Cooper, and J. O. McHugh.
The Science of the Total Environment, Vol. 28, p 215-230, June, 1983. 4 Fig, 6 Tab, 10 Ref.

Descriptors: *Wetlands, *Radioactive wastes, *Path of pollutants, Groundwater pollution, Cobalt radioisotopes, Strontium radioisotopes, Cesium radioisotopes, Bioavailability, Trees, Forests, Radioactive waste disposal, Ontario.

Nuclide speciation and arboreal uptake have been studied in a forested wetland adjacent to a radioactive waste management area at the Chalk River Nuclear Laboratories in Ontario, Canada. A variety of speciation techniques has revealed the presence of anionic species of several radionuclides in the groundwater. In particular, Co-60 exists in solution throughout the wetland predominantly in a very stable, anionic and hydrophilic form. Studies of the concentration of radionuclides in tree sap have shown that there are similarities in the variations in uptake of Co-60, Sr-90 and Cs-137 with time during the Spring. An experiment using bean plants grown in solution culture with contaminated groundwater spiked with cationic Co-57, demonstrated that the anionic forms of Co-60 were less bioavailable than the more labile and cationic forms of cobalt in solution. (Author's abstract)
W84-04746

DISSOLVED AND PARTICULATE METAL CHEMISTRY OF THE CENTRAL AND EASTERN BASINS OF LAKE ERIE,
National Water Research Inst., Burlington (Ontario).
K. R. Lum, and J. K. Leslie.
The Science of the Total Environment, Vol. 30, p 99-109, September, 1983. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Lake Erie, *Metals, *Particulates, Aluminum, Cadmium, Cobalt, Iron, Manganese, Nickel, Lead, Zinc, Seasonal variation, Lake sediments, Phytoplankton, Decomposition, Eutrophication.

Dissolved and particulate forms of Al, Cd, Co, Cu, Fe, Mn, Ni, Pb and Zn were determined in the Central and Eastern Basins of Lake Erie during May, August and September 1978. No temporal or spatial differences in the average concentrations of dissolved Cu, Ni, Al and Fe were observed between May and September. In contrast, Mn and Zn showed significant seasonal variations with Mn having distinct concentration maxima in both basins during September. This behavior is attributed to net release of Mn and Zn from the bottom sediments. Phytoplankton activity is shown to be important in causing large increases (1.8-5.4 times the concentrations in May) in particulate elemental concentrations during the bloom periods. The removal of Cu, Ni, Pb and Zn from the water column is mediated by the decay of plankton populations. (Author's abstract)
W84-04749

Group 5B—Sources Of Pollution

THE SIGNIFICANCE OF ATMOSPHERIC DEPOSITION OF HEAVY METALS IN FOUR DANISH LAKES,

Aarhus Univ. (Denmark). Botanical Inst.
V. J. Larsen.
The Science of the Total Environment, Vol. 30, p 111-127, September, 1983. 3 Fig, 7 Tab, 45 Ref.

Descriptors: *Heavy metals, *Atmospheric deposition, *Lakes, *Denmark, Water pollution sources, Zinc, Copper, Lead, Cadmium, Aquatic plants, Sediments, Macrophytes, Oligotrophic lakes.

The atmospheric deposition rate of heavy metals was determined throughout a seventeen month period at four lakes and a control station across Mid-Jutland, Denmark, and its significance was assessed in relation to the concentrations of Zn, Cu, Pb, and Cd in water, sediment and aquatic macrophytes (Phragmites australis (Cav.) Trin, Littorella uniflora (L.) Ashers., Isoetes lacustris L. and Juncus bulbosus L.) from Lake Hampen, Lake Meldgaard, Lake Sorteso, and Lake Godstrup. Mean annual deposition rates of 1.81-2.77 mg Cu/sq m, 4.09-8.73 mg Pb/sq m, and 0.21-0.37 mg Cd/sq m were determined. For Zn a mean deposition rate of 15 mg Zn/sq m/year was used. The atmospheric deposition per sq m of Zn and Cu amounts to 0.2-37%, 0.05-4.3% and 3.4-107% of the contents present in the water column of the lakes, the upper 10 cm of the littoral sediment and in dense vegetation of aquatic macrophytes, respectively. Equivalent figures for Pb and Cd are 1.8-649%, 0.8-30.6%, and 16.8-951%. In the profundal sediments of the oligotrophic Lake Hampen, post-war atmospheric deposition has increased the heavy metal concentration and content up to 180 times. The Pb concentrations in sediments from different depths were significantly correlated with the post-war consumption of gasoline in Denmark. It is concluded that atmospheric deposition of heavy metals results in a significant contamination of lakes, especially oligotrophic lakes for which aerial fallout is the major source. It is further concluded that lake sediments uncontaminated with heavy metals are probably no longer found in Denmark. (Author's abstract)
W84-04750

CADMIUM ADSORPTION IN FRESHWATERS - A QUANTITATIVE APPRAISAL OF THE LITERATURE,

Edinburgh Univ. (Scotland). Dept. of Geology.
D. P. H. Laxen.
The Science of the Total Environment, Vol. 30, p 129-146, September, 1983. 5 Fig, 6 Tab, 55 Ref.

Descriptors: *Cadmium, *Adsorption, Literature reviews, Hydrogen ion concentration, Suspended sediments, Iron oxides, Clays, Silica, Humic substances, Manganese oxides, Sediments.

Information from 33 studies of cadmium, adsorption on amorphous and crystalline hydrous iron oxides, clays, silica, humic solids, manganese oxides and natural sediments has been collated. The results have been transferred to a unified data base using a surface complexation model, and are presented in terms of conditional adsorption constants as a function of pH. The adsorption constants for a given substrate at a fixed pH generally agree with an order of magnitude. This is reasonable given the wide range of experimental conditions employed. The affinity of the substrates (on a weight basis) for cadmium appears to follow the order Mn > Fe am > chlorite (montmorillonite) > Fe cryst = illite = humics > kaolinite > silica. Application of the experimental conditional adsorption constants for the individual substrates to a model suspended sediment predicts adsorption levels similar to those found in experiments with real sediments. The results confirm the potentially important role played by hydrous oxides of iron and manganese. They also emphasize that cadmium is in a very dynamic regime with respect to adsorption in many freshwaters. Deficiencies in our present information on cadmium adsorption are highlighted and suggestions made for future studies. (Author's abstract)
W84-04751

PREDICTIVE ACCURACY DETERMINATION APPLIED TO A LINEAR MODEL PHOSPHORUS LOADING RESULTING FROM URBAN RUNOFF,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
R. F. Malone, H. Saidi, and K. Wegener.
Applied Mathematical Modelling, Vol. 8, No. 2, p 81-88, April, 1984. 7 Fig, 3 Tab, 14 Ref.

Descriptors: *Mathematical models, *Urban runoff, *Phosphorus, Pollution load, Simulation, Prediction, Storm runoff, Water quality.

A case study of the application of an iterative technique for determination of predictive accuracy is presented. The method uses Monte Carlo simulations and split sampling techniques to verify model accuracy. Examination of the ability of a linear parametric runoff loading model's ability to project total phosphorus loadings reveals the sensitivity of the model to calibration procedures. Predictive reliability was found to vary widely as the number of rainfall events considered in the calibration process changed. Predictive reliability was substantially increased by imposing calibration constraints which ensured that a wide distribution of values of the independent variable were represented in the calibration pool. Although the linear model is theoretically weak in its representation of the runoff loading phenomenon, it displays relatively stable predictive capabilities which warrant its consideration for use in management studies. The predictive errors associated with loading projections limit the linear model's value to applications insensitive to errors in the loading projections for individual storm events. This study provides further evidence of the need to consider uncertainties associated with the modelling of water quality phenomena. (Author's abstract)
W84-04768

5C. Effects Of Pollution

POPULATION BIOLOGY IN THE COURTROOM: THE HUDSON RIVER CONTROVERSY,

Oak Ridge National Lab., TN.
L. W. Barnthouse, J. Boreman, S. W. Christensen, C. P. Goodyear, and W. Van Winkle.
BioScience, Vol. 34, No. 1, p 14-19, January, 1984. 2 Fig, 1 Tab, 30 Ref.

Descriptors: *Decision making, *Model studies, *Hudson River, *Population dynamics, Fish populations, Bass, Environmental effects, Planning, Management, Direct impact accessment, Legislation.

The Hudson River controversy was a unique test of the ability of biologists to use their science to aid public decision makers in achieving an equitable solution to an important environmental problem. Some of the successes and failures of this effort are evaluated, based on years of experience of technical advisors and expert witnesses for the various federal agencies involved in the case. The major issue of the study was the use of mathematical models of fish populations as environmental assessment tools. The first attempt to quantify the impact of water withdrawals on the Hudson River striped bass population was based on a simple comparison of the average daily water withdrawal by the Cornwall facility to the average daily tidal flow of the Hudson. Various models were presented to make the analysis more correct, but the issue of entrainment impacts on striped bass had not been satisfactorily dealt with. This resulted in a remarkable proliferation of entrainment models as agency and utility scientists competed to produce the more realistic models. Each of the many settlement proposals discussed by the negotiators included a package of mitigating measures aimed at reducing the impact of entrainment on the fish. It seems certain that decisions about the need to mitigate the environmental impacts of man's activities will often have to be made on the basis of incomplete information, rather than being deferred indefinitely in the hope that scientists will come up with definitive solutions. (Baker-IVI)
W83-04283

INADEQUACY OF DIVERSITY INDICES IN DISCERNING METAL MINE DRAINAGE EFFECTS ON A STREAM INVERTEBRATE COMMUNITY,

Chadwick and Associates, Littleton, CO.
J. W. Chadwick, and S. P. Canton.
Water, Air and Soil Pollution, Vol. 22, No. 2, p 217-223, 1984. 2 Fig, 1 Tab, 24 Ref.

Descriptors: *Diversity indices, *Metal mine drainage, *Invertebrates, Bioindicators, Measuring instruments, Mine drainage, Water pollution sources, Water pollution effects.

Diversity indices have long been used to assess impacts on stream invertebrate communities. By providing a single value, they allow rapid comparisons between stations without long species lists, density estimates and other parameters that can confuse the non-biologist. The benthic invertebrates of the Dolores River in southwest Colorado were sampled during three seasons in an area of historic mine drainage. Benthic density exhibited significantly lower values below the mine drainage. However, the number of species did not decrease significantly, indicating that the effect of the mine drainage was primarily non-selective (i.e. favoring no one taxon). This pattern was seasonal with the least effects evident in summer and the greatest effects found in spring. Diversity indices used to assess the effects of this stress on the invertebrate community were Margalef's, Simpson's, Shannon-Weaver's, Brillouin's, and the Biotic Condition Index. None of the indices tested adequately responded to a decreasing trend in the benthic density when number of species remained constant. The indices did respond to a combination of low density and number of species. Diversity indices appear to be inadequate in assessing a non-selective stress. (Murphy-IVI)
W84-04212

SIGNIFICANCE OF WATER QUALITY TO FISH PROPAGATION, WATERFOWL HABITAT, LIVESTOCK WATERING, AND RECREATION USE FOR 24 LAKES AND RESERVOIRS IN VALLEY AND PHILLIPS COUNTIES, MONTANA,

Geological Survey, Helena, MT. Water Resources Div.
R. F. Ferreira.
Available from the OFSS, USGS, Lakewood, CO 80225, Price: $8.25 paper copy, $3.50 in microfiche. USGS Water-Resources Investigations Report 83-4008, April 1983. 58 p, 2 Fig, 16 Tab, 37 Ref.

Descriptors: *Reservoirs, *Fish, *Waterfowl, *Livestock, *Swimming, *Water quality, Management planning, Lakes, Algae, Phytoplankton, Trace elements, Nutrients, Dissolved solids, Dissolved oxygen, Eutrophication, Toxicity, Fishkill, Water quality criteria, Valley County, Phillips County, *Montana.

Twenty-four reservoirs were sampled for water quality to determine their suitability for fish propagation, waterfowl habitat, livestock watering, and recreation. Reservoir-surface areas ranged from 0.2 to 146 hectares and depths ranged from 0.01 to 6.0 meters. Of the reservoirs studied, six generally had water quality that would not be detrimental to fish propagation. Most of the reservoirs were enriched with nutrients and supported large concentrations of phytoplankton and dense growth of aquatic plants. In late winter and late summer, enrichment of shallow reservoirs often resulted in dissolved-oxygen concentrations less than 5.0 milligrams per liter, which is detrimental to fish. Three reservoirs lacked aquatic plants for water fowl habitat. Four reservoirs had small dissolved-oxygen concentration in the bottom water that might be critical to the protection of waterfowl if botulism were to occur. Specific conductance of water samples from three reservoirs was sufficiently close to the criterion of 4,800 microsiemens per centimeter at 25 degrees celsius to be regarded as potentially hazardous to livestock. However, most of the reservoirs generally would not be conducive to recreational swimming. Visibility was limited in most of the reservoirs. In addition, leech populations and

growth of submersed aquatic plants in most of the reservoirs would be a nuisance to swimmers. (USGS)
W84-04258

WATER-QUALITY ASSESSMENT OF WHITE RIVER BETWEEN LAKE SEQUOYAH AND BEAVER RESERVOIR, WASHINGTON COUNTY, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
J. E. Terry, E. E. Morris, and C. T. Bryant.
Available from the Ofss, USGS Lakewood, CO 80225, Price: $15.00 paper copy, $15.00 microfiche. USGS Water Resources Investigations Report 82-4063, 1982. 107 p, 22 Fig, 13 Tab, 61 Ref.

Descriptors: *Dissolved oxygen, *Biochemical oxygen demand, Oxygen sag, *Nitrification, Model stimulation, Water pollution, Biological communities, Sources, Sinks, Rearation, *Arkansas, *White River, Fayetteville Wastewater-Treatment Plant, Dissolved oxygen deficit, Dissolved oxygen saturation, Kinetic reactions.

The Arkansas Department of Pollution Control and Ecology and U.S. Geological Survey conducted a water quality assessment be made of the White River and, that a steady-state digital model be calibrated and used as a tool for simulating changes in nutrient loading. The city of Fayetteville's wastewater-treatment plant is the only point-source discharger of waste effluent to the river. Data collected during synoptic surveys downstream from the wastewater-treatment plan indicate that temperature, dissolved oxygen, dissolved solids, un-ionized ammonia, total phosphorus, and floating solids and depositable materials did not meet Arkansas stream standards. Nutrient loadings below the treatment plant result in dissolved oxygen concentrations as low as 0.0 milligrams per liter. Biological surveys found low macroinvertebrate organism diversity and numerous dead fish. Computed dissolved oxygen deficits indicate that benthic demands are the most significant oxygen sinks in the river downstream from the wastewater-treatment plant. Benthic oxygen demands range from 2.8 to 11.0 grams per meter squared per day. Model projections indicate that for 7-day, 10-year low-flow conditions and water temperature of 29 degrees Celsius, daily average dissolved oxygen concentrations of 6.0 milligrams per liter can be maintained downstream from the wastewater-treatment plant if effluent concentrations of ultimate carbonaceous biochemical oxygen demand and ammonia nitrogen are 7.5 (5.0 5-day demand) and 2 milligrams per liter respectively. Model sensitivity analysis indicate that dissolved oxygen concentrations were most sensitive to changes in stream temperature. (USGS)
W84-04259

EFFECT OF SUBLETHAL AND LETHAL CONCENTRATIONS OF FENITROTHION, BHC AND CARBOFURAN ON BEHAVIOUR AND OXYGEN CONSUMPTION OF THE FRESHWATER PRAWN MACROBRACHIUM KISTNENSIS (TIWARI),
Poona Univ. (India). Dept. of Zoology.
K. R. Pawar, and M. Katdare.
Archive fur Hydrobiologie, Vol. 99, No. 3, p 398-403, February, 1984. 1 Tab, 24 Ref.

Descriptors: *Water pollution effects, *Pesticides, *Prawns, *Fenitrothion, *BHC, *Carbofuran, Organophosphates, Organochlorines, Carbamates, Behavior, Oxygen consumption, Toxicity.

The increased manufacture and use of pesticides for controlling crop pests and public health has posed a direct threat to water quality by contaminating aquatic systems. Environmental factors and stress alter the metabolic rates of animals as indicated by the rate of oxygen consumption. Such a change could indicate the effect of pesticides. The behavior and oxygen consumption of adult freshwater prawns, exposed to 96 hr LC50 sublethal and lethal concentrations of three pesticides Fenitrothion, BHC, and Carbofuran were studied. The prawns exposed to the sublethal concentrations showed an initial excitation for a period of 3 to 4 hrs after which they were apparently normal. The marked behavioral changes noted in the lethal concentrations of the pesticides were spontaneous movements, hyperactivity, loss of balance and finally paralysis. In the sublethal and lethal concentrations, prawns showed increased oxygen consumption up to 12 hrs and afterwards a decrease in oxygen consumption. (Baker-IVI)
W84-04279

POWER PLANT IMPACT ASSESSMENT: A SIMPLE FISHERY PRODUCTION MODEL APPROACH,
National Marine Fisheries Service, La Jolla, CA. Southwest Fisheries Center.
A. D. MacCall, K. R. Parker, R. Leithiser, and B. Jessee.
Fishery Bulletin, Vol. 81, No. 3, p 613-619, July, 1983. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Powerplants, *Environmental impact statement, *Model studies, *Fisheries, Cohort, Mathematical models, Mathematical equations, Fish populations, Mortality.

The relative abundance of a cohort affected by power plant entrainment mortality as a fraction (Rc) of the abundance of that cohort in the absence of power plant impact can be calculated by Rc = exp (Eiti) where ti is the duration of life stage i, and Ei is the entrainment mortality rate at stage i. Rate Ei can be estimated by the ratio of nonsurviving entrained organisms during a given time interval to the mean standing crop of stage i organisms in the source water during that interval. An estimate of adult abundance allows calculation of equivalent adult losses. When insufficient information is available to determine the long-term effect on the population, the fishery 'potential yield' formula provides an interim estimate. The methods may be separated into two somewhat independent analyses. The first is short-term assessment, which estimates entrainment impact on a single cohort in the sense of Goodyear's equivalent adult mortality. The second analysis estimates the long-term equilibrium impact of combined removals, including entrainment and impingement by one or more power plants, and all other nonnatural removals, including fishery harvests. As in the case of the 'potential yield' formula, the approximation of long-term equilibrium impact should be discarded when better estimates can be developed. (Murphy-IVI)
W84-04293

CHEMICAL AND TOXICITY ANALYSIS OF LEACHATES FROM COAL CONVERSION SOLID WASTES,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-04326

INCIDENCE OF URBAN SEWAGE DISPOSAL IN THE SALT-PONDS AREAS OF THE SOUTH OF THE BAY OF CADIZ,
Cadiz Univ. (Spain). Dept. of Chemical Engineering.
D. Sales, A. Gomez, and D. Cantero.
Marine Pollution Bulletin, Vol. 14, No. 12, p 447-452, December, 1983. 9 Fig, 3 Tab, 10 Ref.

Descriptors: *Salt marshes, *Tidal effects, *Municipal sewage, *Cadiz, *Spain, Bay of Cadiz, Fish, Aquaculture, Toxicity, Fate of pollutants, Water pollution effects.

The highest pollution indices in the marsh and tidelands situated to the south of the Bay of Cadiz have been evaluated. The salt industry of the area is currently being transformed into mariculture installations. A systematic evaluation was made of different parameters at 26 sampling stations during the period 1976-1981. The quality of the water in the channels studied was adversely affected by urban sewage disposal. The diluting effect of tide water on the sewage diminished noticeably and progressively towards the central area of the study zone. Along the river Iro, there was an appreciable recovery of the watercourse as a result of the action of the tides and a certain amount of self-purification. It is particularly harmful that the sewage outlets from the towns are situated in the area of the meeting of the tides, where the waters are at their most stagnant or renewal is at its least. Different zones were established in the water basin on the levels of quality in the study areas. The results suggest that extensive zones are too seriously affected to make use of them as marine piscifactories. Prior treatment of the urban sewage, and the dredging of the principle channels of the zone may be solutions to the problem. (Baker-IVI)
W84-04328

CLAM BURROWING BEHAVIOUR: INHIBITION BY COPPER-ENRICHED SEDIMENT,
District of Columbia Univ., Washington.
H. L. Phelps, J. T. Hardy, W. H. Pearson, and C. W. Apts.
Marine Pollution Bulletin, Vol. 14, No. 12, p 452-455, December, 1983. 2 Fig, 2 Tab, 14 Ref. Department of Energy contract DE-AC06-76RLO 1830.

Descriptors: *Clams, *Behavior, *Copper, *Sediment, Bioindicator, Toxicity, Bioassay, Bioaccumulation.

Copper is one of the metals most toxic to marine life, but when it enters coastal waters the majority is sorbed by organic suspended material and transferred to sediments. This sorption decreases the cupric ion activity in water and reduces its bioavailability and toxicity to neritic life. Once copper accumulates on the sediment surface, little is known of its effects on infaunal benthos such as clams. Behavioral modification is one of the most sensitive indicators of environmental stress and may directly affect survival. Burrowing behavior is adaptive and allows clams to escape predation; yet the effects of potentially toxic metals on such behavior have not been adequately investigated. In natural marine sediment contaminated with copper the time for littleneck clams (Protothaca staminea) to achieve complete burial was recorded. Above a threshold of 5.8 microg/g Cu added to dry sediment, the time for 50% of the clams to burrow (ET50) increased logarithmically with increasing sediment copper concentration according to: logET50 = 0.15(Cu) - 1.37 (n = 4, sq r = 0.98) where ET50 = time in hours for 50% of clams to burrow and Cu = microg/g Cu in dry sediment. Previously exposed clams had both a lower threshold to Cu and a longer reburrowing time (ET50). Clams exposed to sediment mixed with Chelex-100-sorbed copper showed no significant changes in burrowing time. Bioassays based on clam burrowing behavior can measure both bioeffectiveness of sediment-sorbed metals and a sublethal effect with ecological meaning. (Murphy-IVI)
W84-04329

EFFECTS OF CHRONIC OIL POLLUTION FROM REFINERY EFFLUENT ON SEDIMENT MICROFLORA IN A DANISH COASTAL AREA,
Copenhagen Univ. (Denmark). Inst. for Spore Plants.
H. Gruttner, and K. Jensen.
Marine Pollution Bulletin, Vol. 14, No. 12, p 456-459, December, 1983. 4 Fig, 4 Tab, 16 Ref.

Descriptors: *Oil pollution, *Water pollution effects, *Sediments, *Microflora, *Denmark, *Coastal waters, Petroleum hydrocarbons, Oil refineries, Microbial degradation, Bacteria, Yeasts, Filamentous fungi, Kalundborg Fjord.

Kalundborg Fjord is a Danish marine area which has been heavily oil polluted by refinery effluent, leading to accumulation of petroleum hydrocarbons in the surface sediments. A study of the occurrence in the sediment of heterotrophic bacteria, yeasts and filamentous fungi has been carried out, and the physiological composition of the microbial community has been recorded. Though the abundance of oil-degrading microorganisms was significant, a correlation between the number of these and the oil content of the sediment could not be demonstrated. (Author's abstract)
W84-04330

ENVIRONMENTAL IMPACT IN SANDY BEACHES OF COPPER MINE TAILINGS AT CHANARAL, CHILE,
Universidad Caolica de Chile, Santiago. Facultad de Ciencias Biologicas.
J. C. Castilla.
Marine Pollution Bulletin, Vol. 14, No. 12, p 459-464, 1983. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Environmental impact statement, *Copper, *Mine wastes, *Chanaral, *Chile, Geomorphology, Macrofauna, Population exposure, Population density, Water pollution effects.

Since 1938, untreated copper mine tailings of Potrerillos and El Salvador have been disposed into the sea at Chanaral, Chile (26 degrees 21 min. Lat. S., 70 degrees 42 min. Long. W.). Over 220 x 10 to the 6th power tons of sediments have been dumped. This pollution has caused drastic geomorphologic changes in the c. 16 km contaminated area. The occurrence of new artificial beaches and modification of coastal contours are reported. Sandy beach macrofauna monitoring (1975-1982) demonstrated a progressive lowering of density and biomass in those communities affected by copper mine tailings. (Author's abstract)
W84-04331

THE MICROBIAL ECOLOGY OF THE BRISTOL CHANNEL,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W84-04336

THE EFFECT OF PHOSPHATE ON BACTERIAL BIOMASS PRODUCTION IN WATERS OF LAKES OF THE JORKA RIVER DRAINAGE BASIN,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
W. A. Godlewska-Lipowa.
Polskie Archiwum Hydrobiologii, Vol. 30, No. 4, p 331-341, 1983. 1 Fig, 3 Tab, 43 Ref.

Descriptors: *Phosphate, *Bacteria, *Biomass production, *Jorka River, Productivity, Eutrophic lakes, Eutrophication, Cycling nutrients, Phosphorous, Microbial degradation.

Among the major nutrients, phosphorus comes second after nitrogen in covering the nutritional requirements of all organisms. The bacterial enzymic systems taking part in the metabolism of phosphorus compounds are very specific. Evaluation was made of the effect of inorganic and organic phosphate on the rate of bacterial biomass production in eutrophic lakes, greatly differing in the eutrophication degree. In surface waters, the bacterial biomass varied from a little over 1.0 g/cu dm in Majcz Wielki Lake to more than 5.0 g/cu dm in Glebokie Lake. The action of the phosphates studied proved to be non-equivalent, and their effect differed in dependence on lake and period of the vegetation season. In spring, bacterial biomass production attained - in the presence of lecithin and KH2PO4 - level of 0.160 and 0.185 g C/cu dm. 24 h, respectively. In case of the remaining phosphates, the respective values were somewhat lower. They were lowest for K2H PO4, amounting in spring in Majcz Wielki, Zelwazek and Jorzec Lake to 0.035, 0.111 and 0.139 g C/cu dm times 24 h, respectively. (Murphy-IVI)
W84-04341

FACTOR INTERACTIONS AND AQUATIC TOXICITY TESTING,
For primary bibliographic entry see Field 5A.
W84-04351

FISH IMPINGEMENT AT POWER STATIONS SITUATED ALONG THE RIVERS RHINE AND MEUSE IN THE NETHERLANDS,
Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
R. H. Haddenringh, G. H. F. M. van Aerssen, L. Groeneveld, H. A. Jenner, and J. W. van der Stoep.
Hydrobiological Bulletin, Vol. 17, No. 2, p 129-141, December, 1983. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Powerplants, *Impingement, *Fish, *Netherlands, *Rhine River, *Meuse River, Wall River, Beneden Merwede, IJssel River, Cooling water.

Impingement of fish in cooling water intakes of power stations can result in considerable mortalities. A sampling program was started in 1980 at six power stations on the rivers Wall, Beneden Merwede, IJssel, Meuse and Amer. The survey was confined to the impingement of juvenile and adult fish, that is, the blockage of fish against the fine cooling water screens. The entrained fraction, mainly fish larvae passing through the screens, pumps and condensers, was not considered. Substantial numbers of fish were impinged on the cooling water screens of Harculo, Gelderland, Merwedehaven and Amer power stations. Low numbers were impinged at the two stations located on the river Meuse. Possible reasons for this difference may be a low fish density in the river Meuse and the deep position of the cooling water intakes. In comparison with Bergum power station, situated on a lake, the impingement rate at the river stations was more than ten times as low. Most fish were impinged during the summer months when large numbers of juvenile fish are present in the rivers. Dominating species impinged were roach, pikeperch, bream and perch. The abundance of pikeperch in the screen samples, points to a recent increase in the population of pikeperch in the rivers. Thirty fish species and four crustacean species were collected, among which Orconectus limosus was quite abundant at Maas and Claus power stations. (Baker-IVI)
W84-04377

FOOD OF BLUEGILLS (LEPOMIS MACROCHIRUS) FROM HEATED AND UNHEATED AREAS OF A POWER PLANT COOLING RESERVOIR,
South Dakota Cooperative Fishery Research Unit, Brookings.
R. J. Krska, Jr., and R. L. Applegate.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 325-334, April, 1984. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Powerplants, *Cooling ponds, *Fish, Bluegills, Thermal pollution, Heated water.

Bluegills collected from discharge (heated) and intake (unheated) areas of a power plant cooling reservoir in South Dakota in 1979 were opportunistic feeders. The relative contributions of the various food taxa to the bluegill diet reflected, in many instances, the relative abundances of potential food organisms in the reservoir. Consumption of zooplankton in both areas of the reservoir also generally followed seasonal zooplankton population changes, but was greatest in the discharge area. The seasonally important contribution of aquatic vegetation to the bluegill diet found in this study appeared related to the consumption of animal foods. The greater percentage of non-empty stomachs of bluegills collected in the discharge area appeared related to temperature differences between areas. Fish in heated waters were forced to feed more frequently to maintain their metabolic demands than fish from the intake, cooler, water area. Thus temperature and substrate for food organisms were dominant factors influencing food habits of Big Stone reservoir bluegills. (Baker-IVI)
W84-04382

IN-STREAM DISTRIBUTION AND HYDRAULIC AND ECOLOGICAL EFFECTS OF VOLCANIC ASH FROM MOUNT ST. HELENS ERUPTION,
Idaho Univ., Moscow. Dept. of Civil Engineering.
J. M. Milligan, C. M. Falter, and M. A. Brusven.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84169382, Price codes: A07 in paper copy, A01 in microfiche.
Idaho Water and Energy Resources Research Institute Completion Report, Moscow, October, 1983, 131 p, 40 Fig, 19 Tab, 108 Ref. Project No. OWRT C-10105-V (1466) (1), Contract/Grant No. 14-34-0001-1466.

Descriptors: Sediment transport, Sediment distribution, *Stream ecology, Aquatic environment, *Volcanic ash, Aquatic algae, Aquatic invertebrates, *Mount St. Helens, *Idaho, *Deposition (sediment).

The catastrophic eruption of Mt. St. Helens in southwestern Washington on May 18, 1980 deposited a plume of volcanic ash from Washington to western Montana. Ash deposits in northern Idaho were significant with depth varying from 2 to 3 mm in the fringes to as much as 50 mm in the central area of the plume as it crossed the Idaho panhandle. Varying amounts of the ash were deposited directly in streams located in the plume area. This study is an evaluation of the changes in the in-stream ecological conditions resulting from volcanic ash deposition and transport. This interdisciplinary evaluation of the in-stream effects of the new volcanic ash deposition on the physical and biotic components of streams in the ashfall plume area was studied by recreating, on a simulated basis, conditions prior to, during, and after the ash deposition, and by field verification measurements taken in the Palouse River to support the simulation studies. The results obtained from the simulation and field studies clearly indicate catastrophic influences of volcanic ash deposition and transport on attached benthic algae biomass and on the dislocation of invertebrates and interruption of food-chain relationships. While the shortterm impact was moderate to severe on selected populations, all of the principal species tested demonstrated considerable persistence and resilience such that long-term effects of the ash on the in-stream ecosystem are judged to be minimal.
W84-04405

SALINITY AND TEMPERATURE EFFECTS ON PHOTOSYNTHESIS AND ORGANIC CARBON RELEASE RATES BY SELECTED BENTHIC MACROALGAE,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 2L.
W84-04407

EFFECTS OF ANURAN LARVAE ON AQUATIC PROCESSES ASSOCIATED WITH WATER QUALITY,
New Hampshire Univ., Durham. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W84-04410

MODELING OF WATER QUANTITY AND QUALITY FOR RIVER BASIN PLANNING,
New Hampshire Univ., Durham. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W84-04411

METALLOTHIONEIN INDUCTION, GROWTH, AND SURVIVAL OF CHINOOK SALMON EXPOSED TO ZINC, COPPER, AND CADIUM,
Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, and J. A. McCarter.
Bulletin of Environmental Contamination and Toxicology, Vol. 32, No. 4, p 478-485, April, 1984. 1 Fig, 6 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Salmon, *Campbell River, *British Columbia, *Metallothionein, Zinc, Copper, Cadmium, Heavy metals, Bioassay.

The hazards of metal contamination in the Campbell River to resident and transitory salmonids were explored by exposing chinook salmon eggs obtained from a hatchery to varying degrees of metal contamination. Determinations were made of survival and effects on growth and hepatic metallothionein concentration after long term exposures. Bioassays conducted after hatch, 4 weeks post hatch, and 8 weeks post hatch show greatest metal tolerance after hatch, least tolerance 4 weeks after

natch and a slight increase in tolerance at the button-up stage. Metallothionein concentrations in whole alevins after 4 weeks of metal exposure do not show an increase as the synthesis of metallothionein occurs primarily in the liver, which is only 1% of the body weight of the fish. Hepatic metallothionein concentrations in chinook fry showed marked elevations in proportion to the metal concentrations to which the fish were exposed for 21 weeks. These extremely elevated concentrations reflect a marked biological response to the high concentrations of metals which are entering the fish. (Baker-IVI)
W84-04549

TOXICITY OF URANIUM TO DAPHNIA MAGNA,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
T. M. Poston, R. W. Hanf, Jr., and M. A. Simmons.
Water, Air and Soil Pollution, Vol. 22. No. 3, p 289-298, April, 1984. 5 Tab, 14 Ref. U.S. Department of Energy contract DE-AC06-76RL0 1830.

Descriptors: *Toxicity, *Uranium, *Daphnia, Mine drainage, Mine wastes, Ions, Uranyl, Water pollution sources, Water pollution effects, Columbia River.

Mining and milling of uranium ore can result in the release of U to natural bodies of water. Standard treatment of mine waste water and mill tailing leachates by barium chloride precipitation and neutralization does not significantly reduce U concentrations. The toxicity of U to Daphnia magna was determined in acute and chronic tests. The 48-hr LC50 of U(VI) in Columbia River water was 6 mg/L. Acute toxicity diminished by a factor of 7.5 as mean water hardness and alkalinity values increased from 70 mg/L and 57 mg/L to 195 mg/L and 130 mg/L, respectively. This effect was most likely the result of complexation of uranyl ion with carbonate ions. D. magna reproduction was suppressed in Columbia River water at U concentrations between 0.5 and 3.5 mg/L. Potential hazards of U to aquatic life are discussed as they relate to mining practices. (Murphy-IVI)
W84-04563

BEHAVIORAL RESPONSE OF FISH TO ALTERED WATER QUALITY: A REVIEW OF SELECTED EXAMPLES WITH EMPHASIS ON SALMONIDS,
R. H. Gray.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 84-96, March, 1983. 6 Fig, 2 Tab, 51 Ref. U.S. Dept. of Energy Contract DE-AC06-76RLO.

Descriptors: *Fish behavior, *Water quality, Heated water, Thermal pollution, Powerplants, Salmon, Fish migration, Avoidance, Water pollution effects, Chlorinated hydrocarbons.

The manner in which fish behavior can be modify by the effects of water quality alterations and the implications of this knowledge for assessing environmental effects and designing power generation facilities is described. Based on studies showing that adult migration delays are related to seasonally high ambient water temperatures, adult migrations are not blocked by midriver thermal discharges, and juveniles leave unfavorably high water temperatures, it can be concluded that given a choice, salmon avoid lethal temperatures. Tracking studies also show that adult salmon swim deeper in supersaturated water than in normally saturated water and thus avoid the critical zone and potentially lethal dissolved gas conditions. Fish also avoid chlorinated effluents. Assessment of environmental effects, design and operation of power generation facilities, and decisions regulating thermal and chlorine discharges should not be based solely on lab derived thermal and chemical tolerance data. Design and decisions should be based on an assessment process that considers adaptive behavior of key aquatic species at the site. The interaction of various environmental stimuli and their influence on fish response needs elucidation. Knowledge of the behavioral responses of aquatic organisms to water quality alterations puts thermal and chemical tolerance studies in perspective, and is essential to assessing potential environmental effects. Behavioral responses of organisms must be considered when designing and operating power generation facilities that affect aquatic systems. (Baker-IVI)
W84-04614

EFFECTS OF METALS AND SEDIMENT PARTICLE SIZE ON THE SPECIES COMPOSITION OF THE EPIFAUNA OF PINNA BICOLOR NEAR A LEAD SMELTER, SPENCER GULF, SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Cronulla (Australia). Div. of Fisheries Research.
T. J. Ward, and P. C. Young.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 1, p 79-95, January, 1984. 2 Fig, 6 Tab, 16 Ref.

Descriptors: *Metals, *Particle size, *Sediments, *Species composition, *Pinna, *Lead smelter, *Spencer Gulf, *Australia, Cadmium, Copper, Lead, Zinc, Bryozoa, Mollusks, Coastal waters, Bioaccumulation, Industrial wastes, Bioindicators, Population exposure, Water pollution effects.

Pinna bicolor (Mollusca: Pelecypoda) were transplanted between four sites near a lead smelter. The species composition of their epifauna (sessile and mobile) was examined in relation to characteristics of both sediments and seston at the sites. Seventy-two taxa were distinguished in the epifaunal community. Substantial differences were found in the short-term sensitivity of some of the species to concentrations of Cd, Pb and Zn in sediments and to sediment particle size. The short-term sensitivity of many species to metals or sediment particle size explained their long-term distribution pattern. Twenty-three taxa were identified as significantly characterizing the faunal differences. Of these, eleven (four mollusks, four bryozoans, two barnacles and one ascidian) were affected by both sediment metal concentrations and particle size, and eight (four mollusks, one bryozoan, one polychaete, one hydroid and one barnacle) were affected by metal contamination but not particle size. Of all fauna examined, the Bryozoa were the most metal-sensitive. Four species, Smittina raigii (Bryozoa), Galeolaria sp. 1 (Polychaeta), Epopella simplex (Cirripedia) and Monia ione (Pelecypoda) were identified by their short- and long-term sensitivity to metal contamination, and absence of sensitivity to sediment particle size, as suitable species for monitoring the effects of metal contamination on the epifauna. The implications of the results for toxicity-testing are discussed. (Author's abstract)
W84-04631

BIOCHEMICAL EFFECTS OF LONG-TERM EXPOSURE TO CADMIUM AND COPPER ON RAINBOW TROUT (SALMO GAIRDNERI): VALIDATION OF WATER QUALITY CRITERIA,
Genova Univ. (Italy). Ist. di Zoologia.
A. Arillo, D. Calamari, C. Margiocco, F. Melodia, and P. Mensi.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 106-117, April, 1984. 4 Tab, 47 Ref.

Descriptors: *Biochemical effects, *Long-term exposure, *Cadmium, *Copper, *Rainbow trout, *Water quality standards, Bioassay, Bioindicators, Blood catalase, Carbonic anhydrase, Liver aminolevulinate dehydrase, Leucylaminopeptidase, Mucus lysozyme, Sialic acid, Bioaccumulation.

Salmo gairdneri specimens were exposed for 4 months to 1-10 microg/liter of Cd and 30-100 microg/liter of Cu. At different times from the beginning of the experiment the activity of some metal-sensitive enzymes was assayed (blood catalase and carbonic anhydrase; liver aminolevulinate dehydrase and total leucylaminopeptidase). Under long-term exposure, a subsequent unbalance between mucus secretion and excretion occurs, leading to a depletion in sialic acid content and a consequent decrease in mucus chelator capacity. After 4 months of treatment - an impairment of important biochemical functions such as respiratory control ratio and oxygen consumption (state 3) in mitochondria and an alteration in lysosomal functions (increase in free LAP activity), carbonic anhydrase activity in blood, sialic acid content in gills, and ALA-D activity in liver for copper treatments at both WQC and 'effective' levels. It can be concluded that Cd WQC apparently are acceptable, whereas those for copper need to be revised. (Murphy-IVI)
W84-04635

PHYSIOLOGICAL EFFECTS OF AN ADDITIONAL STRESSOR ON FISH EXPOSED TO A SIMULATED HEAVY-METAL-CONTAINING EFFLUENT FROM A SULFIDE ORE SMELTERY,
National Swedish Environment Protection Board, Nykoeping.Brackish Water Toxicology Lab.
A. Larsson, C. Haux, M-L. Sjobeck, and G. Lithner.
Ecotoxicology and Environmental Safety, Vol. 8, No. 2, p 118-128, April, 1984. 5 Tab, 26 Ref.

Descriptors: *Physiological effects, *Perch, *Heavy metals, *Sulfide ore smelter, Industrial wastes, Water pollution effects, Anemia, Hypocalcemia, Hyperglycemia, Toxicity, Skelleftea Bay, Sweden, Simulation analysis.

Perches (Perca fluviatilis), kept in slightly hypotonic brackish water, were exposed to dilutions of a simulated heavy-metal-containing effluent from a sulfide ore smeltery. Biochemical and hematological effects of the effluent, as well as the metal residues in liver and muscle tissues, were investigated after 12 and 27 days of exposure. The metal analyses revealed no significant uptake of metals in liver and muscle during the experiment. In spite of this, the exposed fish showed several physiological effects. Some of these, e.g., anemia, hypocalcemia, increased muscle water content, and reduced liver size, were of a transient nature, while others, such as disturbed chloride balance and hyperglycemia, seemed to be more persistent. At the end of the experiment (29-33 days of exposure), the physiological response to stress treatment (asphyxia) and a subsequent recovery were studied in exposed and unexposed fish. This stress investigation indicates that an additional stressor may strengthen the toxic effects of the heavy-metal-containing effluent. Furthermore, the secondary stress responses were more pronounced and the ability to recover from them seemed to be impaired in exposed fish as compared to unexposed fish. (Author's abstract)
W84-04636

COMPARISON OF SEASONAL AND DIURNAL PATTERNS OF SOME PHYSICO-CHEMICAL PARAMETERS OF THE OPEN AND CLOSED PARTS OF LOKTAK LAKE, MANIPUR, INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
D. K. Banerjee, B. Bhatia, and I. Haq.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 243-250, October, 1983. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Physicochemical properties, *Loktak Lake, *Manipur, *India, Seasonal variation, Diurnal distribution, Water pollution effects, Dissolved oxygen, Acidity.

A comparative study of the periodic and aperiodic variations of some physico-chemical parameters of the open and closed parts of the Loktak Lake, Manipur, India, was carried out for a 3 year period from 1976-78 to investigate possible effects of human activities on these variations. In both the open as well as the closed lake the pH displayed a clear seasonal variation, with the highest values in winter and the lowest values during the post monsoon period. In the open lake the seasonal variations of DO were similar to those of pH, with high values during winter and low in the post-monsoon period. In the closed lake there was no pattern of seasonal change in the DO. Post-monsoon peaks of chloride values for the year 1976 and 1978 were clearly seen in the open and closed lakes. Distinct diurnal patterns were discernible,

both in the closed and open lakes. The diurnal pattern of free carbon dioxide in the bottom samples from the closed lake were characterized by lower values in the day and higher values in the night. The bottom samples in the closed lake were different from the surface samples of the closed lake and from the surface and bottom samples of the open lake in that there were consistent diurnal patterns and relationships between the pH, free carbon dioxide, carbonate ions, calcium ions, and other parameters. These observations suggest that deviations from the normal expected diurnal variation pattern of simple physico-chemical parameters and of the relationship between these may possibly serve as a useful criterion of the degree of perturbation to which a lake is subjected due to human or natural causes. A direct instead of an inverse relationship between the diurnal variation of carbon dioxdide and pH in the open lake, the mechanism of which remains unexplained, may also have some significance in indicating unstable conditions in the lake. (Baker-IVI)
W84-04658

BIOLOGICAL EFFECT OF SOME POISONS ON CANTHOCAMPTUS (CRUSTACEA SPP),
All-India Inst. of Hygiene and Public Health, Calcutta. Dept. of Sanitary Engineering.
S. V. Rama Rao, and K. J. Nath.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 271-275, October, 1983. 5 Tab, 9 Ref.

Descriptors: *Biological effects, *Poisons, *Canthocamptus, Crustacea, Water quality standards, Toxicity, Ecological effects, Bioaccumulation, Water pollution effects.

Water quality standards are generally based on the effect of a single toxicant; unfortunately, the additive effects of a mixture of toxicants are never taken into account when implementing water quality standards. This paper evaluates the additive effect of a mixture of toxicants on Canthocamptus (Crustacea spp). The results suggest that the toxicity of certain toxicants like phenol is increased when the poison is present in combination with heavy metals or other poisons. The results of this study point to the need for greater care when fixing up the permissible level of the toxicants; in all cases, the relevant agencies should take into consideration the additive effect of a mixture of toxicants. (Murphy-IVI)
W84-04659

THE EFFECT OF CHRONIC OIL POLLUTION ON SALT-MARSH NITROGEN FIXATION (ACETYLENE REDUCTION),
William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
For primary bibliographic entry see Field 2L.
W84-04669

EFFECTS OF DREDGING AND OPEN-WATER DISPOSAL ON BENTHIC MACROINVERTEBRATES IN A SOUTH CAROLINA ESTUARY,
South Carolina Wildlife and Marine Resources Dept., Charleston. Marine Resources Research Inst.
R. F. Van Dolah, D. R. Calder, and D. M. Knott.
Estuaries, Vol. 7, No. 1, p 28-37, March, 1984. 2 Fig, 2 Tab, 14 Ref. Army Corps of Engineers contract DACW60-77-C-0013.

Descriptors: *Environmental effects, *Ecological effects, *Open-water disposal, *Benthic macroinvertebrates, *South Carolina, *Estuaries, *Dredging, Sediments, Ocean dumping.

Approximately 28,475 cu m of muddy sediments were dredged from a shoal in a South Carolina estuarine system and released near the surface at a nearby site having high tidal current velocities. Effects at the dredged sites included decreased macrofaunal abundance and changes in species composition. These effects appeared to be short term, which substantial recovery occurring within 3 months. Rapid recovery was primarily attributed to immigration through slumping of channel wall sediments similar to those dredged. Detrimental effects on benthic macrofauna in the area of open water disposal were minimal. Most differences noted in community structure between collection dates were attributed to sampling and seasonal variability. The absence of a major longterm disruption to the benthos in the disposal area was probably due to (1) strong tidal currents, which rapidly dispersed the moderate amount of mud sediments released; (2) surface disposal, permitting wider dispersal; and (3) disposal during late autumn, a period of low faunal recruitment. (Author's abstract)
W84-04670

EFFECT OF POLLUTION ON PHYTOPLANKTON IN THE ASHAR CANAL, A HIGHLY POLLUTED CANAL OF THE SHATT AL-ARAB ESTUARY AT BASRAH, IRAQ,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad, and S. E. Antoine.
Hydrobiologia, Vol. 99, No. 3, p 189-196, March, 1983. 2 Fig, 2 Tab, 34 Ref.

Descriptors: *Estuaries, *Water pollution effects, *Phytoplankton, *Ashar Canal, *Shatt al-Arab estuary, *Basrah, *Iraq, Wastewater disposal, Chemical properties, Species composition, Pollution load.

The effect of pollution on the phytoplankton in the Ashar Canal was studied during March and June 1976. Higher temperatures were recorded in June. The canal water was more turbid than that of the adjoining Shatt al-Arab estuary due to high algal populations and sewage disposal. The chlorosity values were remarkably high in the canal, due to sewage disposal. The flood waters in June lowered the chlorosity in both estuary and canal. Sewage disposal into the canal decreased its dissolved oxygen content. The lower oxygen values in the estuary in June were accompanied with higher temperatures. The pH values were generally higher in the estuary and were also higher in June than in March. Eighty-six algal taxa were recorded, 45 of which were diatoms. The phytoplankton in the estuary was more abundant in March, due to the increase in currents and turbidity in June. The Chlorophyta, Conjugatophyta, Myxophyta and Bacillariophyta in the estuary showed reverse seasonal trends from those of the total phytoplankton. These algae seemed to flourish during periods of high temperatures. The dense blue-green algae recorded in June is attributed to the high temperature and dissolved organic matter. The Chyrosphyta recorded high populations in the estuary in March and were totally absent in June. Lower temperatures and high transparency in March might have led to their relative abundance. The total phytoplankton in the Ashar Canal followed two different seasonal trends, one resembling and the other differing from those in the estuary. The disposal of domestic sewage and agricultural wastes in the canal seemed to lead to such adverse seasonal variations. The diatoms only dominated the phytoplankton at one station in both months. The sewage and agricultural wastes disposal seemed to favor the abundance of the other phyla than the diatoms. Increased organic load in the canal has led to a considerable increase in the Myxophyta in June. Blooms of Chlamydomonas sp. and Euglena acus increased the phytoplankton densities in March at stations II and IV, respectively. Benthic or periphytic algae were found in the phytoplankton populations. Raised salinity seemed to restrict the distribution of the planktonic diatom Bacillaria paradoxa. Among the noticeable widespread planktonic algae in the study area are Dinobryon sertularia, Pediastrum duplex and P. simplex. (Author's abstract)
W84-04680

BACTERIOPLANKTON IN THE ACIDIFIED LAKE GARDSJON,
Swedish Water and Air Pollution Research Lab., Goeteborg.
I. B. Andersson.
Hydrobiologia, Vol. 101, No. 1/2, p 59-64, April, 1983. 5 Fig, 1 Tab, 24 Ref.

Descriptors: *Bacterioplankton, *Acidic lakes, *Gardsjon Lake, Forest hydrology, Biomass, Hydrogen ion concentration, Bacteria, Chemical properties.

Total bacterial numbers in different strata of lake water and in inlet and outlet streams have been recorded during a yearly cycle. A calculated mean cell volume of 0.342 sq micro m has then been used to estimate bacterial biomass in the lake. Change of biomass during the year was substantial and the range was from about 0.1 g/cu m to about 1.0-1.2 g/cu m. The seasonal development included a spring-early summer increase followed by a decrease to the minimum in July-August. Correlation between epi- and hypolimnion was high and in both strata two dominant autumn peaks in biomass appeared. With the exception of the last autumn peak the development of bacterial biomass was closely related to development of phytoplankton biomass and production. (Author's abstract)
W84-04701

EFFECTS OF CHANGES IN DISCHARGE LEVEL ON TEMPERATURE AND OXYGEN REGIMES IN A NEW RESERVOIR AND DOWNSTREAM,
Guelph Univ. (Ontario). School of Engineering.
For primary bibliographic entry see Field 6G.
W84-04710

NUTRIENT AND OXYGEN REDISTRIBUTION DURING DESTRATIFICATION IN THE ELEFSIS BAY, AN ANOXIC BASIN,
Institute of Oceanographic and Fisheries Research, Athens (Greece).
For primary bibliographic entry see Field 2H.
W84-04713

INVERTEBRATES AND URBAN RUNOFF IN A SMALL NORTHERN STREAM, EDMONTON, ALBERTA, CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
E. R. Whiting, and H. F. Clifford.
Hydrobiologia, Vol. 102, No. 1, p 73-80, May, 1983. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Invertebrates, *Urban runoff, *Edmonton, *Alberta, *Canada, Environmental effects, chemical properties, Species diversity, Bioindicators.

The invertebrate fauna of a small northern stream was examined within Edmonton, Alberta. Many invertebrates that were common upstream of the city were absent or rare within the city. In contrast, some tubificids and chironomids were very abundant within the city. Diversity and richness (number of taxa) of the fauna were much lower within Edmonton than upstream, while the total density was much higher within the city. These changes in the urban invertebrate fauna were apparently caused by the discharge of organic materials and silt from storm sewer runoff. Chemical analysis of routinely-collected water samples did not show significant differences between urban and non-urban sites. This was probably due to the sporadic nature of storm sewer runoff. Peak levels of contaminants in the stream were usually missed because of the routine nature of sampling. Aquatic invertebrates, which exhibit long-term responses to sporadic runoff incidents, provided a better indication of stream water quality than did routine chemical monitoring. (Author's abstract)
W84-04716

EFFECT OF SOME SURFACE-ACTIVE ANIONIC AGENTS ON DAPHIA MAGNA STRAUS,
Akademiya Nauk URSR, Kiev. Inst. Biokhimii.
I. I. Lesyuk, N. I. Igumentseva, A. A. Lemishko, and S. I. Kusen.
Hydrobiological Journal, Vol. 19, No. 2, p 64-68, 1983. 4 Tab, 5 Ref.

Descriptors: *Surfactants, *Daphnia, Water pollution effects, Toxicity, Sodium sulfoethoxylate, Sodium olefinsulfonate, Sulfonates, Reproduction.

The survival and fecundity of Daphnia were studied in the presence of the anionic surfactants

sodium sulfoethoxyalate and sodium olefinsulfonate. Sodium sulfoethoxylate, with a C10 to C13 carbon chain, proved much more toxic than sodium olefinsulfonate with a C12 to C14 carbon chain. Their median lethal concentrations for the initial Daphnia population over 25 days of study are 78 and 126 mg/liter, respectively. The maximum tolerated concentrations are 27 and 79.8 mg/liter and absolute lethal concentrations are 129 and 177 mg/liter, respectively. Daphnia of the first and second generations are more sensitive to surfactants than in the initial generation. Daphnia fecundity is an inverse function of surfactant concentration. (Baker-IVI)
W84-04726

ZOOPLANKTON AND FEEDING OF YOUNG FISH IN THE ZONE OF DISCHARGE OF EFFLUENTS FROM THE TRIPOL'YE POWER PLANT,
Tikhookeanskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistava i Okeanograffii, Vladivostok (USSR).
L. V. Voronchuk, O. I. Kudrinskaya, and S. F. Matchinskaya.
Hydrobiologia, Vol. 19, No. 3, p 35-40, 1983. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Zooplankton, *Feeding rates, *Fish, *Tripol'ye powerplant, *Discharge measurement, Thermal pollution, Water pollution effects, Fish behavior, Cladoceran, Rotifers, Fish food organisms, Fish diets, Biomass.

The zooplankton, the zoophytes and the feeding patterns of the fry of the most abundant fish species of the Kanev Reservoir during the summers of 1976 and 1977 were studied. The studies were conducted at Tripol'ye, near the point of warm water discharge from the power plant and at Khodorov, 50 km downstreams. The biomass and numbers of zooplankton in these areas were similar, with an average of 0.57 mg/liter and 62 individuals/liter, respectively. The smallest biomass was observed at Khodorov in 1977. The species composition of zooplankton was, however, different: cladoceran species were abundant in the Tripol'ye area, whereas at Khodorov a predominance of rotifers, small cladocerans and larvae of Dreissena were found. The fingerlings at Tripol'ye were better provided with food because of a better food base. (Murphy-IVI)
W84-04731

ORGANIC AND CHLORIDE POLLUTION IN LAKE NAINI TAL (INDIA),
Kumaun Univ., Naini Tal (India).
S. N. Das, and R. S. Bora.
Hydrobiological Journal, Vol. 19, No. 3, p 46-49, 1983. 1 Tab, 16 Ref.

Descriptors: *Lake Naini Tal, *India, *Organic compounds, *Chloride, Water pollution effects, Seasonal variation, Dissolved solids, Oxygen, Municipal wastewater, Dissolved oxygen, Detergents.

Seasonal dynamics and distribution of different organic matter fractions (dissolved, suspended and settled) were studied in the highland lake Naini Tal, India. Intense contamination of this lake has been caused by municipal wastes, which leads to organic matter accumulation and low oxygen content of the water. The silt covers the lake bottom with a layer 10 to 15 cm thick, high in organics whose decomposition liberates large volumes of ammonia and hydrogen sulfide. The chloride concentration varied from 26.0 mg/l in July to 34.0 mg/l in September. Chloride did not fluctuate so strongly as dissolved organic matter, settled organic matter or suspended organic matter, indicating that the chloride pollution is more or less constant throughout the year, whereas the input of organic pollutants varied significantly. Strong pollution with fecal matter, detergents and domestic drainage water was noted in the Talli Tal, as this area receives sewage from the many hotels in the city as well as houses and the Ramsay Hospital. The oxygen content correlated strongly with the settled and dissolved organic matter concentrations rather than with the suspended organic matter. (Baker-IVI)
W84-04732

POLLUTANT EFFECTS ON THE MIXED FUNCTION OXYGENASE (MFO) AND REPRODUCTIVE SYSTEMS OF THE MARINE POLYCHAETE NEREIS VIRENS,
Delaware Univ., Newark. School of Life and Health Sciences.
C. R. Fries, and R. F. Lee.
Marine Biology, Vol. 79, No. 2, p 187-193, 1984. 5 Fig, 1 Tab, 45 Ref. NSF grants OCE-8017893 and OCE-8016644.

Descriptors: *Water pollution effects, *Mixed function oxygenase, *Reproductive systems, *Polychaetes, *Nereis virens, Cytochrome P-450, Polychlorinated biphenyls, Oil pollution, Marine environment.

The cytochrome P-450 dependent mixed-function oxygenase (MFO) system of Nereis virens, found in the endoplasmic reticulum of the intestinal epithelium, has similar components and cofactor requirements when compared to other invertebrates. Worms exposed to food containing benzo(a)pyrene or a mixture of polychlorinated biphenyls (Aroclor 1254) had significantly higher MFO activity and cytochrome P-450 content than unexposed ones. N. virens from a site in Portland, Maine, USA, which was heavily contaminated with oil, and nearby 'clean' reference sites were studied. The weight, MFO activity and presence or absence of gametes were determined. The MFO activity in worms from the oil-contaminated site was approximately six times that of worms from the reference sites; worms from the reference areas were six times larger than oil-contaminated worms. Worms from the oil-contaminated area lacked or had undeveloped gametes in spring, summer and fall. In contrast, many of the worms collected from the reference sites at the same times had fully developed gametes. (Author's abstract)
W84-04737

COPPER SPECIATION IN SOFT, ACID, HUMIC WATERS: EFFECTS ON COPPER BIOACCUMULATION BY AND TOXICITY TO SIMOCEPHALUS SERRULATUS (DAPHNIDAE),
Michigan State Univ., East Lansing.
J. P. Giesy, A. Newell, and G. J. Leversee.
The Science of the Total Environment, Vol. 28, p 23-36, June, 1983. 2 Fig, 9 Tab, 52 Ref. DOE contract DE-AC09-76SR00819.

Descriptors: *Copper, *Chemical speciation, *Bioaccumulation, Chelation, Simocephalus, Toxicity, Organic matter, Well water, Pond water, Simulation, Mathematical models.

Comparative studies were conducted using water from a shallow pond and from a deep artesian well which is the primary water source for the pond. These waters are of very similar water quality, except for higher concentrations of dissolved organic carbon in the pond. The stoichiometry and affinity (conditional stability constants) of Cu chelation by naturally-occurring organic ligands were determined by numerical solutions of Scatchard relationships. These values were then used in the geochemical speciation model, GEOCHEM, to determine the relative importance of each Cu species in dynamic equilibrium with competing metals and ligands. The accumulation of Cu by and toxicity of Cu to the soft water cladoceran Simocephalus serrulatus (Daphnidae) were measured and related to Cu speciation. When 10 micro g Cu/L were added to pond water in the fall, the distribution of Cu was: Cu(++), 36.0%; Cu-organic, 63%; CuOH(-), 0.5% and CuSO4, 0.5%. The organics in pond water reduced Cu accumulation and toxicity. When the 24 h-LC50 values were reported as Cu(++), this species of copper was more toxic in pond water than well water. The toxicity of Cu may not be directly proportional to Cu accumulation by microcrustaceans. (Moore-IVI)
W84-04738

SUBLETHAL RESPONSES OF MYTILUS EDULIS TO INCREASED DISSOLVED COPPER,
Lawrence Livermore National Lab., CA.
F. L. Harrison, J. R. Lam, and R. Berger.
The Science of the Total Environment, Vol. 28, p 141-158, June, 1983. 5 Fig, 7 Tab, 37 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Mytilus, *Copper, *Toxicity, Lysosomal enzymes, Protein binding, Bioindicators, Heavy metals, Water pollution effects, Enzymes, Mortality.

The mussel Mytilus edulis, because of its worldwide distribution, is used extensively as an indicator of metals. Two processes important in metal metabolism in mussels are the binding of metals to low molecular weight proteins which have some properties similar to those of metallothioneins and the incorporation of metals into membrane-bound vesicles which are similar in appearance to some lysosomes. Changes in the composition of copper-binding proteins and in the latency of lysosomal enzymes were detected in digestive gland cells of Mytilus edulis exposed to metals. Chronic exposure to copper resulted in concentrations of copper in low-molecular weight metallothionein-like proteins that were dependent on exposure concentration and time, and in a dose-dependent reduction in the latency of lysosomal hexosaminidase activity. A direct relationship between the copper concentration associated with the high molecular weight proteins and the mortality of mussels was observed. Mussels can detoxify elevated concentrations of soluble copper in the water, but the ability of the organisms to tolerate the copper is related to the exposure concentration and duration. (Moore-IVI)
W84-04745

THE EFFECTS OF DREDGING ON SEDIMENTS, PLANKTON AND FISH IN THE VAUVERT AREA OF LAKE ST. JEAN, QUEBEC (EFFET DU DRAGAGE SUR LES SEDIMENTS, LE PLANCTON ET LES POISSONS, DANS LA REGION DE VAUVERT AU LAC ST-JEAN, QUEBEC),
Quebec Univ., Chicoutimi. Dept. des Sciences Fondamentales.
L.-M. Lalancette.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 463-477, 1984. 4 Fig, 5 Tab, 21 Ref.

Descriptors: *Dredging, *Lake St. Jean, *Quebec, *Sediments, Plankton, Fish, Environmental effects, Turbidity, Water pollution effects, Suspended particulates.

In 1977, the electrolysis and chemical company, Alcan, began dragging the shoreline of the Vauvert area of Lake St. Jean with a view to its restoration. Later in 1977 and in 1978, experiments were conducted to determine the impact of the dredging on sediments, plankton and fish. It was discovered that after dredging sediments lose their cohesion and its fine particles are dispersed by the currents; it also appeared that the nature of the dispersed sediment in the form of particles facilitated their return to the lake by the medium of wind, rain and waves. It was found that during dredging operations, because of turbidity, plankton decreases but then grows back very quickly when dragging is ended. The effects of the dragging were therefore of short duration. Finally, the results of the dragging operations relating to fish were inconclusive; however, a turbidity such as that at Vauvert, created in a laboratory, irritates the gills of fish and after some weeks the gills and the fish lose all their color. In the long run the turbidity kills the fish. (Author's abstract)
W84-04754

THE EFFECTS OF RAPID TEMPERATURE DECREASES BY FIVE FRESHWATER FISH SPECIES,
West Virginia Dept. of Natural Resources, Elkins. Div. of Wildlife Resources.
D. A. Cincotta, J. R. Stauffer, Jr, and C. H. Hocutt.
Archiv fur Hydrobiologie, Vol. 99, No. 4, p 529-536, March, 1984. 1 Tab, 37 Ref.

Descriptors: *Temperature effects, *Fish, Mortality, Cold shock, Cold resistance, Water temperature, Shiner, Dace, Pumpkinseed, Bass.

Instantaneous cold shock experiments were conducted on five species of freshwater fish acclimated to two temperatures between 24 and 36 degrees C. Golden shiner fish acclimated to 30 and 35 degrees C exhibited over 50% mortality when exposed to 12 degrees C. Satinfin shiner, when acclimated to 24 and 30 degrees C, found cold shock temperatures of 6 and 12 degrees C lethal, respectively. Blacknose dace, when acclimated to 24 and 28 degrees C, found lethal cold shock temperatures to be 6 degrees C. Pumpkinseed, when acclimated to 30 and 36 degrees C, found temperatures at which 50% or more mortality occurred in 10,000 min to be 12 and 18 degrees C, respectively. Largemouth bass specimens acclimated to 30 and 36 degrees C exhibited over 50% mortality when exposed to 12 degrees C. (Baker-IV)
W84-04757

NANOPLANKTON: CHIEF PRIMARY PRODUCERS IN LAKE NAINITAL,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W84-04758

ALGAL BLOOM OF THE FLAGELLATE SYNURA UNVELLA IN THE KLINGENBERG AND LEHNMUHLE DRINKING WATER RESERVOIRS - ITS EFFECTS ON THE DRINKING WATER SUPPLY AND ITS TREATMENT (DIE MASSENENTWICKLUNG DER GEIBELALGE SYNURA UVELLA IN DEN TRINKWASSERTALSPERREN KLINGENBERG UND LEHNMUHLE - IHRE AUSWIRKUNGEN AUF DIE TRINKWASSERVERSORGUNG UND IHRE BEKAMPFUNG),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
For primary bibliographic entry see Field 5F.
W84-04791

5D. Waste Treatment Processes

DESILTING OF INTAKE AND OUTLET WORKS OF THE BLAYAIS PLANT (CONCEPTION, REALISATION ET DEVASAGE DES OUVRAGES DE PRISE ET DE REJET D'EAU DE REFROIDISSMENT DE LA CENTRALE DU BLAYAIS),
Electricite de France, Paris. Region d'Equipement
J. Laurent, M. Davesne, F. Lemelle, and J. Ricco.
La Houille Blanche, No. 3/4, p 281-290, 1983. 10 Fig, 15 Ref.

Descriptors: *Desilting, *Intake gates, *Outlets, *Blayais Dam, Hydraulic design, Sedimentation, Mudflows, Mud, Spillways, Gironde estuary.

The Blayais plant on the Gironde estuary comprises four 900 MW units. The coolant water systems have been designed for optimum dilution of heat and to minimize recirculation effects while reducing the hydraulic and sedimentary impact on the estuary. Mud had clogged 4/5 th of the diameter of this 2200 m long piping following the successive immersion of 20 meter long sections in water with a high suspended sediment content, and E.D.F. had to deal with the problem of clearing it out. To avoid all risk of clogging on entry into service, the mud was eroded via an increase in the flow achieved by modulating the number of pumps in operation in relation to the working pressure of tides, and changes in the cross-section secured by a temporary cofferdam downstream of a provisional spillway installed for the purpose of discharging the excess mud. (Author's abstract)
W84-04225

MICROBIAL ATTACHMENT PROPERTIES IN EXPANDED-BED, ACTIVATED CARBON ANAEROBIC FILTERS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y. T. Wang, M. T. Suidan, and B. E. Rittman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159730, Price codes: AO4 in paper copy, AO1 in microfiche. Water Resources Center Research Report No. 181, October, 1983. 52 p, 9 Fig, 6 Tab, 69 Ref. Project No. OWRT A-111-ILL (1), Contract/Grant No. 14-34-0001-2115.

Descriptors: Acetate, *Anaerobic filter, *Activated carbon, Expanded bed, Methanogenesis, Kinetics, Organic carbon, *Wastewater treatment, Model studies, Steady state biofilm kinetic model.

A completely mixed, expanded-bed, anaerobic granular activated carbon filter was operated on synthetic wastewaters in which acetate was the only organic carbon source. Steady-state performance was achieved for two influent acetate concentrations: namely, 800- and 1,600 mg/l. Steady-state removal efficiencies in chemical oxygen demand, dissolved ogranic carbon, and acetate exceeding 96, 97, and 98 percent were obtained, respectively. A steady-state biofilm kinetic model was employed for analyzing the two sets of 'steady-state' data. The modeling effort was successful in describing trends and effects; however, insufficient data were available to properly calibrate the model and obtain reliable values for the parametric constants.
W84-04228

PREDICTIVE MODELS FOR ACTIVATED SLUDGE TREATMENT OF TOXIC INDUSTRIAL WASTE COMPONENTS,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Gaudy, Jr., A. F. Rozich, and P. C. D'Adamo.
Availble from the National Technical Information Service, Springfield, VA 22161 as PB84-159722, Price codes: A02 in paper copy, A01 in microfiche. Delaware Water Resources Center Completion Report, November, 1982. 15 p, 2 Tab, 12 Ref. Project No. OWRT A-051-DEL (1), Contract/Grant No. 14-34-0001-2108.

Descriptors: *Activated sludge treatment, *Industrial wastes, *Biological treatment, *Phenols, *Wastewater treatment, Design, Operation, Performance.

Controversy exits regarding the most applicable modeling practice for design and operation of activated sludge processes treating waste containing significant portions of toxic organic compounds. The project research was undertaken to determine whether a non-inhibitory function (e.g., the Monod relationship) or one of several inhibitory functions (e.g., the Haldane equation) could more aptly describe the relationship between specific growth rate and substrate concentration. Phenol was employed as the potentially toxic carbon source in both bench-scale pilot plant studies and batch growth studies. In over 100 batch growth studies it was shown that, regardless of length of acclimation and source of microbial population, an inhibitor function was applicable. Of the five such functions tested for fit of the experimental data, the Haldane equation was selected as most representative and the most readily applicable to engineering calculations for predictive modeling of the performance of the continuous flow pilot plant. Both experimental results and analytical study of the design and operational equations led to the conclusion that the inhibitory function should be employed for treatment of phenolic waste. Values of the biokinetic constants were determined and a method for predicting critical growth rate (dilute-out) for the process was developed.
W84-04236

USE OF WATER HYACINTH AQUATIC TREATMENT SYSTEMS FOR AMMONIA CONTROL AND EFFLUENT POLISHING,
Roseville Public Works Dept., CA.
J. R. Hauser.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 219-225, March, 1984. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Plant populations, Water hyacinth, Turbidity, Chlorination, Harvesting, Suspended solids, Aeration, Ponds, Mosquitos, Biochemical oxygen demand, Ammonia.

The results of a 2 year pilot program investigating the use of water hyacinth aquatic treatment systems for ammonia removal and effluent polishing at a 0.52 cu m/s wastewater treatment plant in Roseville, California are presented. During the warm season, the test systems reduced ammonia by more than 70% in nonaerated ponds and 99% in a pond with supplemental aeration. Total nitrogen reductions in the warm season were approximately 55 and 70% for the nonaerated ponds and the aerated pond, respectively. Routine harvesting was not required to ensure good treatment performance. Harvesting did not improve overall ammonia or total nitrogen reductions in the warm season and led to lesser reductions in the cold season. Effluent BOD-5 and suspended solids levels were typically well below 10 mg/L. Winter die-back of hyacinths led to excessive organic loading in the late winter and spring and caused production of sulfides and concomitant odors in unmanaged ponds. Ease of effluent disinfection by chlorination was greatly enhanced by aquatic treatment. A substantial increase in effluent turbidity and suspended solids occurred temporarily after harvesting. Mosquito development was adequately controlled by mosquito fish. (Baker-IVI)
W84-04323

NITROGEN REMOVAL FROM MUNICIPAL WASTEWATER BY A SINGLE SUBMERGED FILTER,
Kobe Univ. (Japan). Dept. of Civil Engineering.
Y. Iida, and A. Teranishi.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 251-258, March, 1984. 5 Fig, 5 Tab, 7 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Denitrification, *Nitrogen removal, Nitrogen, Sludge, Filtration, Nitrification.

An attached, combined sludge system was evaluated for nitrogen removal. The system required internal carbon sources for denitrification. An attempt was made to achieve carbon oxidation, nitrification, and denitrification of municipal wastewater in a single submerged filter. The nitrogen removal efficiency was affected by the ratio of aeration on to aeration off in an intermittent aeration cycle, detention times, effluent recycle ratios, and wastewater temperature. In single pass studies, which were carried out at wastewater temperatures above 20 degress C, nitrogen removal of about 65% was achieved with an 11 hr detention time and a 2 hr on 2 hr off intermittent aeration cycle. Nitrogen removal of about 55% occurred when the detention time was shortened to 7 hr at a 2 hr on 2 hr off intermittent aeration cycle. Effluent recycling improved nitrogen removal. The advantages to the system included simplicity of installation and operation, absence of any sludge recycling, low sludge production, no supplemental chemical feed for denitrificaton and pH control, and reduction of aeration time. (Baker-IVI)
W84-04325

OBSERVATIONS ON THE USE OF IRON(III) COMPLEXING AGENTS TO FRACTIONATE THE TOTAL FILTERABLE IRON IN NATURAL WATER SAMPLES,
Freshwater Biological Association, Ambleside (England).
J. D. Box.
Water Research, Vol. 18, No., 4, p 397-402, 1984. 7 Fig, 35 Ref.

Descriptors: *Iron, *Filtration, *Natural waters, Complexometry, Fractioning, Chemical properties, Water analysis.

The analysis for iron in natural waters is complicated by the chemistry of iron in aqueous solution which has resulted in the use of a wide range of analytically defined categories. Analysis of filtered

atural water samples using Fe(II) complexing gents (bathophenanthrolinedisulfonic acid, 2,2'-di-yridyl, ferrozine, TPTZ) and acetic acid-sodium cetate buffer (pH 4.6) showed that the absorbance f the iron(III) complex increased with time both n the presence and the absence of a reducing agent ascorbic acid, hydroxylammonium chloride). Ex-osure of the samples to 0.1 M H Cl (pH approxi-nately 1.3) for 1 h prior to the addition of the complexing agents resulted in a stable iron concen-ration which was designated the acid-extractable raction of the total filterable iron. The results have mplications for the complexometric determination f iron fractions other than total iron after acid igestion. (Murphy-IVI)
W84-04349

PENTACHLOROPHENOL BIOGRADATION-I; ANAEROBIC,
Purdue Univ., Lafayette, IN. Environmental Engi-neering Lab.
M. A. Guthrie, E. J. Kirsch, R. F. Wukasch, and C. P. L. Grady, Jr.
Water Research, Vol. 18, No. 4, p 451-461, 1984. 7 Fig, 2 Tab, 18 Ref.

Descriptors: *Biological wastewater treatment, *Biodegradation, *Anaerobic digestion, *Pentach-orophenol, Pesticides, Methanogenesis, Sludge di-gestion, Bacteria.

The fate of pentachlorophenol (PCP) during an-aerobic digestion of sewage sludge solids was tested in a three phase protocol. Phase I involved acclimation: Phase II investigated biodegradation n semicontinuous-flow, stirred-tank reactors at solids retention times of 10, 20, and 40 days; phase III assessed the importance of nonbiological re-moval mechanisms and collected additional data concerning the extent of biodegradation. PCP was found to inhibit methanogenesis in unacclimated cultures at concentrations in excess of 200 microg/l and thus acclimation of the digesters to PCP required very gradual increases in the influent con-centration thereby allowing enrichment of orga-nisms capable of degrading PCP. Once acclimation was achieved, digestors receiving influent contain-ing 5.0 mg/l PCP achieved stable operation with effluent PCP concentrations below 5 microg/l at all retention times studied. Sorption was shown to be unimportant in PCP removal. Volatilization was considered to be unimportant based upon results obtained in forced aeration studies. This suggested that PCP was subject to at least primary biodegra-dation. Other evidence collected during the study indicated that more complete biodegradation prob-ably was occurring. (Author's abstract)
W84-04352

PHOSPHORUS REMOVAL IN A SEWAGE TREATMENT PLANT AND PLANT BIOMASS IN AN EFFLUENT RECEIVING LOWLAND STREAM,
East Brabant Dept. of Technology, Boxtel (Neth-erlands).
F. A. Kouwe.
Hydrobiological Bulletin, Vol. 17, No. 2, p 143-156, December, 1983. 8 Fig, 10 Tab, 13 Ref.

Descriptors: *Aquatic weed control, *Wastewater treatment, *Phosphorus removal, *Beerze, *Neth-erlands, Macrophytes, Aquatic weeds, Biomass, Streams, Streamflow.

The possibility of controlling plant growth by low-ering the phosphorus concentration of the stream water through phosphorus removal in a sewage treatment plant was investigated. Biomass develop-ment, the role of the sediment, the natural phos-phate concentration of streams, the phosphorus, nitrogen and potassium content of plants were studied. Decreasing the phosphorus concentration in the lowland stream Beerze by means of P-reduction with ferrosulfate in the sewage treatment plant Hapert did not lead to a decrease in biomass of aquatic macrophytes in this stream. To achieve a substantial decrease in the production of plant biomass by lowering the P-concentration of the water more measures are needed than P-reduction in sewage treatment plants only. Measures should be taken to reduce or possibly even to eliminate the influence by agricultural activities and storm-water overflows as well as the removal of nutrient rich sediments. (Baker-IVI)
W84-04378

THE EFFECTS OF INCREASED SALINITY LEVELS ON THE REACTION OF BIOLOGI-CAL WASTEWATER TREATMENT,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
T. A. Dillaha, III, and W. J. Jolan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84163153, Price codes: A01 in paper copy, A01 in microfiche. Technical Report No. 37, July, 1983. 50 p, 3 Fig, 10 Tab, 27 Ref, 1 Append. OWRT A-028-GUAM (1), 14-34-0001-2112.

Descriptors: *Biological wastewater treatment, *Salinity, *Stabilization ponds, *Wastewater treat-ment, Aerobic conditions, Micronesia, Biochemical oxygen demand.

A series of eight 31 liter bench-scale aerobic waste stabilization ponds were operated for 73 days to assess the potential performance of waste stabiliza-tion ponds in Micronesia and to determine how elevated salinity levels affect pond kinetics. The outdoor reactors were loaded with screened raw domestic sewage and operated on a draw and fill basis. Salinity levels in the reactors varied from 600 to 36,000 mg/l with detention times ranging from 6.2 to 15.5 days. The mean influent values for biochemical oxygen demand, BOD5 and suspend-ed solids, SS, were 86.7 and 61.9 mg/l, respective-ly. The mean effluent values for the last 20 days of the experiment ranged from 2.3 to 11.2 mg/l BOD5 and from 3.8 to 44.3 mg/l SS. Reactor 1, which contained no supplemental salt, consistently had the highest treatment efficiency. All of the reactors met the EPA secondary treatment stand-ard of less than 30 mg/l BOD5 but all the saline reactors had SS concentrations in excess of 30 mg/l. Effluent SS concentrations were high in the saline reactors and very low in the freshwater reactor. The results of this study show that waste stabilization ponds are an extremely viable waste treatment option in Micronesia.
W84-04404

WATER RECYCLE IN THE ORGANIC CHEMI-CAL AND PLASTIC MATERIALS INDUS-TRIES,
Centec Corp., Reston, VA.
For primary bibliographic entry see Field 3E.
W84-04406

WASTE-MANAGEMENT INFORMATION FOR DECISION MAKING,
Michigan State Univ., East Lansing. Dept. of Agri-cultural Engineering.
D. R. Heldman.
Food Technology, Vol. 37, No. 12, p 41-43, De-cember, 1983. 2 Fig, 11 Ref.

Descriptors: *Food-processing wastes, *Decision making, Planning, Wastewater treatment, Food processing industry, Model studies.

The food processing industry contributed signifi-cantly to the loads in waste streams leading to the waterways as a result of the large quantities of waste material generated during most types of food processing and the biological activity associated with these materials. At least two feasible ap-proaches to waste management include the reduc-tion of food product solids entering the waste streams, and the conversion of waste materials into usable by-products. Efficient management requires detailed information on the raw product entering the processing operation. The influence of each of the processing steps will have a definite effect on the product and on the amount and types of waste streams generated. Some of the most valuable in-formation comes from the direct analysis of waste streams. However, such analysis does not usually provide insight into the sources of the various components. To illustrate the use of processing-waste information in decision making, two models for processing-waste reduction are compared. The first model is for monitoring product losses associ-ated with a series of individual processing stages, and the second is for determining the feasibiliy of introducing a by-product recovery facility into a waste stream before the final waste-treatment stage. Use of both models would lead to the maxi-mum potential for waste-treatment reduction. The first model provides assurance that the maximum amounts of raw product are converted into pri-mary product and are not entering the food proc-essing waste stream. The second model provides assurance that the minimum quantities of the the primary waste stream are allowed to reach the waste-treatment system. (Baker-IVI)
W84-04422

A NOTE ON FLUORIDE REMOVAL BY RE-VERSE OSMOSIS,
State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
B. R. Min, A. L. Gill, and W. N. Gill.
Desalination, Vol. 49, No. 1, p 89-93, January, 1984. 1 Fig, 13 Ref. NIH Grant 150-HO81L.

Descriptors: *Reverse osmosis, *Fluoride, *Wastewater treatment, Membrane processes, In-dustrial wastes.

Various types of fluoride are discharged by steel, aluminum, glass, phosphate, electroplating, weld-ing, and ceramic industries. There is increasing interest in the use of reverse osmosis for wastewater treatment because it is simple and there is no lower limit to the fluoride concentration of the permeate which may be obtained. Reverse osmosis membrane transport data for sodium fluo-ride solutions are correlated by a linear plot of 1/the reject coefficient versus 1/the total volume flux. The slope of the plot is independent of feed concentration over a 5-fold range from about 360 to 1800 ppm. The reject coefficient at infinite volume flux is slightly less than unity. (Baker-IVI)
W84-04556

WATER QUALITY IMPACTS OF BIOCHEMI-CAL OXYGEN DEMAND UNDER TRANSFER-ABLE DISCHARGE PERMIT PROGRAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
E. D. Brill, Jr., J. W. Eheart, S. R. Kshirsagar, and B. J. Lence.
Water Resources Research, Vol. 20, No. 4, p 445-455, April, 1984. 11 Tab, 16 Ref.

Descriptors: *Water quality, *Biochemical oxygen demand, *Transferable discharge permits, Water quality management, Cost analysis, Dissolved oxygen, Water quality control, Willamette River, Delaware River estuary.

Biochemical oxygen demand is an important exam-ple of water pollutants that degrade biochemically and affect water quality according to the location as well as the strength of the discharge. Therefore, it is important to examine carefully the potential water quality impacts of a program of transferable discharge permits (TDP's) to regulate these dis-charges prior to the implementation of such a program. This paper provides a framework for evaluating these impacts and illustrates trade-offs among cost efficiency, equity, and uncertainty with respect to meeting water quality goals. Exam-ples are given for the Delaware River estuary and the Willamette River. Violations of the standard could occur under a TDP program. Restrictions on the market could be used, however, to control or possibly to eliminate such violations. Limits on the total discharge in sections of the basin, zone boundaries for markets, and revaluation factors for transferred permits were effective individually or in various combinations. Even with these restric-tions, however, there is sufficient flexibility so that significantly more cost-efficient solutions are ob-tained than under direct regulation programs that treat all discharges uniformly. (Murphy-IVI)
W84-04568

CONTROLLING DISCHARGES OF WATER PLANT WASTES TO THE OHIO RIVER,

Ohio River Valley Water Sanitation Commission, Cincinnati.
A. H. Vicory, and L. Weaver.
American Water Works Association Journal, Vol. 76, No. 4, April, 1984. 3 Fig, 1 Tab.

Descriptors: *Water pollution control, *Wastewater management, *Ohio River, Wastewater disposal, Sedimentation, Coagulation, Filtration, Pollution load.

The question of regulating discharges of water plant wastes to the Ohio River was recently addressed by the Ohio River Valley Water Sanitation Commission. A study undertaken in 1981 indicated that effluents from the drinking water treatment plant processes of sedimentation, coagulation, and filtration contributed little or no additional loading to the river. Across-the-board, technology-based requirements for removing waste solids prior to discharge were therefore deemed inappropriate because of the cost of such systems with no benefit to the receiving waters. The policy adopted allows controlled release of such discharges on a case-by-case basis, provided that no adverse effects on designated stream uses will result. (Author's abstract)
W84-04579

BIOLOGICALLY INDUCED VARIATIONS IN THE NATURE AND REMOVABILITY OF THM PRECURSORS BY ALUM TREATMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, K. L. Dixon, J. K. Malone, J. T. Novak, and C. W. Randall.
American Water Works Association Journal, Vol. 76, No. 4, April, 1984. 16 Fig, 4 Tab, 18 Ref. OWRT project A-087-VA.

Descriptors: *Alum treatment, *Biological properties, *Trihalomethanes, Algae, Heterotrophic organisms, Fate of pollutants, Dissolved solids, Claytor Lake.

A study was conducted to examine whether biological activity in a reservoir, which is partly responsible for seasonal variations in finished water trihalomethane (THM) concentrations, could affect the efficiency of alum coagulation in removing THM precursors. Alum coagulation reduced THM precursors by about 50 percent, and its effectiveness did not appear to be altered by variations in algal or bacterial population densities in the lake. Alum coagulation reduced THM precursors by about 50%, and its effectiveness did not appear to be altered by variations in algal or bacterial population densities. The yields of THMs from the remaining DOC, however, were generally greater when biological activity in the reservoir was high. Diurnal variations in the levels of high-THM-yielding precursors, caused by intense biological activity, could affect the ability of a water treatment plant to produce water with THM levels consistently less than the maximum contaminant level of 0.10 mg/L. (Murphy-IVI)
W84-04582

THE COAGULATION OF HUMIC SUBSTANCES BY MEANS OF ALUMINUM SALTS,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
B. A. Dempsey, R. M. Ganho, and C. R. O'Melia.
American Water Works Association Journal, Vol. 76, No. 1, p 141-150, April, 1984. 11 Fig, 3 Tab, 76 Ref. EPA grant R808104.

Descriptors: *Coagulation, *Humic Substances, *Aluminum salts, Aluminum, Hydrogen ion concentration, Organic carbon, Polyaluminum chloride, Wastewater treatment, Performance evaluation.

Mechanisms for the removal of humic substances from water by coagulation with aluminum salts were studied by means of conventional jar test procedures. The type of aluminum coagulant has a very strong effect on conditions (pH and log Al sub T) under which removal of FA will occur, as well as on the extent of FA removal. Removal of humic substances was determined by measuring total organic carbon or by direct ultraviolet spectroscopy. Use of alum appears to be preferable within the sweep floc pH zone, whereas the PACl that was used in these experiments is a better coagulant at all pH values more acidic and at some pH values more basic than the alum sweep floc zone. At pH < 5, removal may occur by the direct precipitation of FA by monomeric species of aluminum. Between pHs 5 and 6 the predominating reaction depends on the applied dosage of aluminum; at low dosage the FA will be precipitated by polymers of aluminum. At pH > 7, removal of FA occurs by adsorption of FA or soluble FA-aluminum complex on a precipitate of Al(OH)3(s). These generalizations are based on indirect evidence, including the effects of sulfate, type of FA, and concentration of FA on FA removal. The type of fulvic acid has a strong impact on the zones where removal of FA occurs. Strong FA-aluminum complexation hinders the removal of FA when precipitation of Al(OH)3(s) or formation of polymers of aluminum is necessary for removal (pH > 5); strong FA-aluminum complexation enhances the removal when direct precipitation of FA by monomeric aluminum can occur (pH < 5). The choice of coagulant for the removal of FA will depend on the FA type and concentration, pH and pH buffering, certain other components of the water, the volume of sludge that is generated, and the availability and cost of the coagulants. Polyaluminum chloride, an unconventional coagulant in the United States, is a promising alternative to alum for removing humic substances from some water supplies. (Murphy-IVI)
W84-04583

THE REMOVAL OF ORGANIC HALIDE PRECURSORS BY PREOZONATION AND ALUM COAGULATION,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
D. A. Reckhow, and P. C. Singer.
American Water Works Association Journal, Vol. 76, No. 4, p 151-157, April, 1984. 21 Fig, 1 Tab, 33 Ref. EPA grant R-810235.

Descriptors: *Organic halides, *Preozonation, *Alum coagulation, Wastewater treatment, Ozonation, Alum, Coagulation, Organic compound, Organic carbon, Trihalomethane, Comparison studies, Chlorination, Ultraviolet radiation.

An increased awareness of potentially carcinogenic micropollutants in US drinking waters has led to a reevaluation of several well-established treatment techniques. The major focus of this concern has been on the recently recognized hazards of chlorination - the formation of both trihalomethanes and total organic halides. Coagulation has also been the subject of renewed investigation because of its ability to remove halogenated organic precursors. Trichloroacetic acid, dichloroacetic acid, dichloroacetonitrile, and 1,1,1-trichloroacetone were formed during the pH 7 chlorination of all aquatic humic materials tested. Chloroform comprised approximately 20% of the TOX, whereas trichloroacetic acid and dichloroacetic acid accounted for about 18 and 6%, respectively. Alum coagulation removed all precursors tested (THM, TOX, TCAA, DCAA, DCAN, and 1,1,1-trichloroacetone) to a significant extent. The percentage removals showed the same trends as, but were not identical to, the percentage removals for TOC and UV absorbance. In contrast to coagulation, UV absorbance was destroyed to a far greater extent during preozonation than the THM, TOX, or trichloroacetic acid precursors. Similarly, TOC was removed by ozonation to a much lesser extent than the THM, TOX, or trichloroacetic acid precursors. Ozonation at 0.3 and 1.2 mg O3/mg C, at natural bicarbonate levels and pH 7, hindered the alum coagulation of organic precursors and the coagulation of TOC and UV-absorbing substances. This diminished overall removal as a result of preozonation was seen both with an aquatic fulvic acid solution and a moderately colored raw drinking water. (Murphy-IVI)
W84-04584

BIOLOGICAL ACTIVATED CARBON-AT WHAT COST,
Philadelphia Water Dept., PA.
H. M. Neukrug, M. G. Smith, S. W. Maloney, and I. H. Suffet.
American Water Works Association Journal, Vol. 76, No. 4, p 158-167, April, 1984. 15 Fig, 16 Tab, 33 Ref.

Descriptors: *Biological activated carbon, *Activated carbon, Oxidation, Ozonation, Wastewater treatment, Cost analysis, Cost-benefit analysis, Water treatment facilities, Delaware River, Philadelphia, Pennsylvania.

The combination of oxidation by ozonation and adsorption by granular activated carbon is commonly referred to as the biological activated carbon process. Used as a basis for this evaluation are the operating conditions and results of a three-year, pilot-scale investigation of advanced water treatment systems that was conducted on Delaware River water in Philadelphia, PA. Ozonation prior to GAC treatment decreases organic loads applied to the GAC bed, increases organic biodegradability, and provides for viral and bacterial disinfection without producing chlorinated by products. On the other hand, the potential exists for the production of oxidation by-products with unknown effects on health and for a decrease in GAC service life for removal of volatile halogenated organics. Further, although volatilization significantly reduces the concentrations of volatile organics, it merely converts a water pollution problem into an air pollution problem. The cost of preozonation is not sufficiently offset by lower GAC operating costs when removal of volatile halogenated organic compounds is the criterion controlling GAC service life. For TOC reductions, preozonation is a cost-effective measure, but other, more conventional, treatment options may offer equal system performance at lower total costs. For odor control, both GAC and ozone-GAC consistently performed well. Again, however, the absence of any improvement with preozonation makes its use uneconomical for taste and odor reductions. For Philadelphia's consumers a conversion to install GAC or ozone-GAC options would increase (depending on the criterion chosen) from 14 to 24% the price of water for all consumers. Although these increases at first appear reasonable, the estimates are for the Torresdale plant only. Conversion of all three plants could cost an additional 75 to 100% of the estimates shown. Since the costs to the consumer would be substantial, the water utility must appraise the consumer's readiness to spend additonal dollars for GAC or ozone-GAC treatment. (Murphy-IVI)
W84-04585

PREVENTING HALOFORM FORMATION IN TREATED SURFACE WATER: A CASE STUDY,
Technion - Israel Inst. of Tech., Haifa.
Y. Argaman, S. E. Shelby, Jr., J. S. Davis, S. C. Betts, and R. J. Hufft, Jr.
American Water Works Association Journal, Vol. 76, No. 4, p 172-176, April, 1984. 7 Tab, 8 Ref.

Descriptors: *Water pollution prevention, *Haloforms, *Treated water, Trihalomethanes, Chloramine, Comparison studies, Disinfection, Ozonation, Granular activated carbon, Pilot plants, Water treatment facilities.

In the United States, the EPA has established a maximum contaminant level (MCL) of 0.10 mg/L for total trihalomethanes in finished drinking water. The growing concern over this contaminant is a result of evidence that some trace organics have carcinogenic and mutagenic properties. Treatment of a surface water was investigated in bench-scale and pilot-plant tests that consisted of flocculation, settling, filtration, granular activated carbon (GAC) treatment, and ozonation. Either GAC treatment or ozonation was necessary to meet the color limit of 15 Co-Pt units. Disinfection with a free chlorine residual without formation of high trihalomethane (THM) levels could only be achieved on GAC-treated effluent. Application of chlorine dioxide resulted in very low THM levels. The required dosage, however, was high unless preceded by GAC treatment. Chloramine could be used as a disinfectant with any of the treatment

chemes without resulting in THMs or other nown public health problems. (Murphy-IVI)
V84-04587

SIMPLIFIED MODELS FOR DESIGN OF FIXED-BED ADSORPTION SYSTEMS,
Michigan Technological Univ., Houghton. Water nd Waste Management Programs.
D. W. Hand, J. C. Crittenden, and W. E. Thacker.
ournal of Environmental Engineering, Vol. 110, No. 2, p 440-456, April, 1984. 3 Fig, 2 Tab, 33 Ref. NSF grant CME 79-24589.

Descriptors: *Model studies, *Design criteria, *Fixed-bed, *Adsorption, Homogeneous surface diffusion model, Organic compounds, Water quality, Water quality control, Mathematical models.

Fixed-bed adsorber dynamics have been predicted successfully using the homogenous surface diffusion model (HSDM) for over 100 adsorbate-adsorbent systems which include a number of the possibly harmful organics that may be found in drinking water and wastewater. Solutions to the HSDM for fixed-bed adsorber systems have been developed and can be used to: (1) Plan the scope of pilot-scale studies by identifying least-cost fixed-bed adsorber operations; (2) interpret pilot-scale test results; and (3) design full-scale adsorbers if the HSDM can simulate pilot-scale data. To facilitate the use of these solutions, the important model parameters and their effect on adsorber performance has been discussed; additionally, a detailed procedure for determining the effluent concentration history profile has been presented. Techniques to calculate the empty bed contact time of the mass transfer zone and the liquid-and solid-phase concentrations within the fixed bed have also been provided. (Author's abstract)
W84-04599

SURFACE TENSION OF POLLUTED WATERS AND TREATED WASTEWATER,
Ibadan Univ. (Nigeria). Dept. of Preventive and Social Medicine.
M. K. C. Sridhar, and C. R. Reddy.
Environmental Pollution (Series B), Vol. 7, No. 1, p 49-69, 1984. 4 Fig, 10 Tab, 14 Ref.

Descriptors: *Surface tension, *Polluted water, *Treated water, *Wastewater, Wastewater analysis, Water properties, Physical properties, Physical analysis, Water analysis.

A comprehensive study was made on the measurement of surface tension of natural waters, artificially polluted waters, domestic wastewater and effluents obtained by treating wastewater by different physical, chemical and biological methods. There was a significant negative correlation between the surface tension and the oxidizable organic matter (3 min PV) and a significant positive correlation between dissolved oxygen content and the surface tension. Oils and detergents reduced the surface tension of water to the minimum level. The biological treatment improved surface tension values to such an extent that the final quality resembled pure water. The vorticellid group of protozoa played an important role in the increase of surface tension of wastewater. (Author's abstract)
W84-04625

BORON CONTROL IN POWER PLANT RECLAIMED WATER FOR POTABLE REUSE,
Raymond Kaiser Engineers, Inc., Oakland, CA.
J. M. Wong.
Environmental Progress, Vol. 3, No. 1, p 5-11, February, 1984. 2 Fig, 5 Tab, 30 Ref.

Descriptors: *Reclaimed water, *Boron, Water reuse, Water treatment, Wastewater treatment, Drinking water, Public health, Ion exchange resins, Reverse osmosis.

An engineering study was conducted on boron control in reclaimed water for potable reuse. The scope of the study included literature research on health effects of boron in drinking water and its effect on sanitary wastewater treatment systems. In addition, an evaluation was made of the potential boron-removal processes, including pilot-column ion-exchange resin testing. It included cost estimates and selection of the most desirable boron-removal process for the potable system. On the basis of test data, strong-base anion exchange is recommended as a boron-control process for the treatment of evaporator effluent. (Baker-IVI)
W84-04628

RECYCLING INDUSTRIAL WASTES BY LAND APPLICATION,
Anheuser-Busch Companies, Inc., Bakersfield, CA. Environmental Engineering and Resources.
L. W. Keith, and D. L. Stack.
Environmental Progress, Vol. 3, No. 1, p 53-56, February, 1984. 1 Fig, 4 Tab.

Descriptors: *Land disposal, *Wastewater disposal, *Food-processing wastes, Industrial wastes, Bakersfield, California, Wastewater irrigation.

Land application of compatible industrial effluents is a cost-effective and environmentally acceptable method of achieving resource conservation and recycling. A yeast plant began an evaluation of land application in 1975 in Bakersfield, CA in order to relieve the loading on that city's wastewater treatment plant of a high-strength by-product stream from the yeast facility. The primary objectives of their various land application projects include: allowing timely production facility expansion; alleviate overloading problems of existing mechanical wastewater treatment systems; reduce overall wastewater-disposal costs; reduce energy consumption compared to conventional wastewater-treatment and commercial fertilizer production; recycle of nutrients and water from the production process; and provide an aesthetically appealing wastewater treatment system with the elimination of discharge of effluents to surface waters. The company has proven that full-scale land-application of high-strength wastewaters can be done successfully. A land-application system is complex and requires detailed design and extensive operational management. The combination of land application and intensive agricultural activities results in the degree of site management required for successful effluent utilization. The necessity for site preparation required to assure proper drainage cannot be overemphasized. Land application, when properly designed and operated, does meet its primary objective of recycling nutrients and water to the end in an energy-efficient and cost-effective manner. (Baker-IVI)
W84-04629

REMOVAL OF PHENOL USING WATER HYACINTH IN A CONTINUOUS UNIT,
Excel Industries Ltd., Bombay (India).
S. Vaidyanathan, K. M. Kavadia, M. G. Rao, S. Basu, and S. P. Mahajan.
International Journal of Environmental Studies, Vol. 21, No. 2, p 183-191, August, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Biological wastewater treatment, *Hyacinth, *Phenols, Economic factors, Industrial wastes, Organic compounds, Wastewater treatment.

In an attempt to apply water hyacinth as a low cost treatment system for phenol, experimental runs on a continuous unit were performed. Phenol in concentrations of 25 mg/l, 100 mg/l, and 125 mg/l was added to the overhead tank, hyacinth and control tank. Nutrients were added. Detention times of 24 hours and 36 hours were kept and flow rate adjusted. For a particular retention time and flow rate, the effluent concentration from the overflow pipe was analyzed in triplicate for phenol. After the effluent concentration corresponding to the influent concentration had acquired a stable value, the contents of the tank were drained and influent concentrations were changed. This procedure was repeated for different flow rates and concentrations. The removal efficiency was correlated with influencing parameters such as organic loading and hydraulic loading. The correlation offered a simple tool for the optimal design of a water hyacinth system for phenol on an industrial scale. (Baker-IVI)
W84-04656

GROWTH STUDIES OF AZOLLA PINNATA RBR. IN A PERMANENT POND,
Indian Inst. of Tech., New Delhi. Centre for Rural Development and Appropriate Technology.
T. S. Kumar, P. Vasudevan, and S. V. Patwardhan.
International Journal of Environmental Studies, Vol. 21, No. 3-4, p 296-300, 1983. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Biological wastewater treatment, *Azolla, *Spirodela, Water hyacinth, Aquatic plants, Aquatic weeds, Biomass,.

The growth pattern of Azolla pinnata in association with Spirodela polyrhiza was studied in a permanent pond. These two plants would provide a regular source of biomass. The suitability of integration of Azolla pinnata into other aquatic plant-based wastewater treatment systems has been proposed. Azolla pinnata offers favorable qualities as a component in wastewater treatment systems. An Azolla-water hyacinth system is also supported by the findings reported. In fact, Azolla may be preferred over duck weed in waste water systems along with water hyacinth, as the interspace between water hyacinth plants may offer a favorable micro-environment for Azolla's growth in the form of protection from direct sunlight in summer months due to the canopy of water hyacinths. This association may lead to a continuous culture of Azolla rather than periods of isolation in summer. (Baker-IVI)
W84-04660

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; I. SEWAGE TREATMENT AND EFFLUENT DISCHARGE,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. N. Lester.
The Science of the Total Environment, Vol. 30, p 1-44, September, 1983. 8 Tab, 190 Ref.

Descriptors: *Heavy metals, *Wastewater treatment, Literature reviews, Biological wastewater treatment, Primary wastewater treatment, Sedimentation, Flocculation, Settling, Microorganisms, Bacteria, Toxicity, Effluents, Water pollution effects, Water reuse.

The literature concerning the significance and behavior of heavy metals in waste waters is reviewed. Factors influencing the partition of heavy metals between the solid and liquid phases in both primary and secondary (biological) treatment are considered in detail. It is evident that during primary treatment only metals present in an insoluble form will be removed, but the removal of such forms is strongly influenced by the factors controlling sedimentation. During secondary treatment metals initially present as soluble forms may be removed by association with the settleable biomass; further removal of insoluble metals also occurs by association with this biomass. Efficient flocculation and settling is critical to the removal of all metal forms during secondary treatment. Extracellular material, principally bacterial extracellular polymers, but also proteins and nucleic acids released as the result of cell lysis, appear to play a very significant role in the removal of soluble metals during secondary treatment. If biological treatment plants are overloaded with metals, toxic effects on bacteria and other microorganisms may result in poor quality effluents; although the micro-organisms responsible for waste water treatment are able, within limits, to acclimatize to elevated metal concentrations. The impact of heavy metal contaminated effluents on receiving waters has also been reviewed and it is concluded that the most serious problem posed is drinking water production in areas where water reuse is practiced. (Author's abstract)
W84-04747

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; II. SLUDGE TREATMENT AND DISPOSAL,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. N. Lester, R. M. Sterritt, and P. W. W. Kirk.
The Science of the Total Environment, Vol. 30, p 45-83, September, 1983. 2 Fig, 16 Tab, 156 Ref.

Descriptors: *Sludge disposal, *Sludge treatment, *Heavy metals, Literature reviews, Anaerobic digestion, Land disposal, Toxicity, Chemical speciation, Bioavailability, Groundwater pollution, Marine pollution, Legislation, Standards.

The literature concerning the significance and behavior of heavy metals in sewage sludge treatment and following sludge disposal is reviewed. Particular attention is given to metal form during anaerobic digestion and following sludge disposal to agricultural land and to sea, and the influence of metal form on toxicity. It is evident that anaerobic digestion results in a strong association between sludge particulates and heavy metals due to the formation of inorganic precipitates, organo-metallic interactions and by association with the biomass. Toxic inhibition of anaerobic digestion by metals is concluded to be a direct result of the free metal ion concentration and thus mechanisms designed to reduce metal toxicity are based on artificial modification of heavy metal speciation in the digester. Guidelines and legislation designed to limit the application of sludge to agricultural land and the disposal of sludge to sea are reviewed and discussed. Following the application of sludge to agricultural land significant changes occur in heavy metal speciation, which ultimately determine metal availability to plants and potential contamination of groundwaters. Guidelines for application to land currently take limited account of metal form, although the importance of metal speciation is being recognized. Sludge disposal to sea has received relatively little attention with efforts being directed towards monitoring rather than more fundamental research. However, it is apparent that significant heavy metal solubilization may occur following sludge discharge to the marine environment. It is concluded that sludge disposal to agricultural land and sea, which are increasingly becoming subject to more stringent international pressures, should take account of the ultimate forms of heavy metals in the receiving environment and that a more unified approach should be adopted in the formulation of standards for all forms of sludge disposal. (Author's abstract)
W84-04748

RESULTS AND GOALS OF THE SAALE-WERRA WATER MANAGEMENT AREA IN RATIONAL WATER USE (ERGEBNISSE UND AUFGABEN DER WASSERWIRTSCHAFTS-DIREKTION SAALE-WERRA BEI DER RATIONELLEN WASSERVERWENDUNG),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
For primary bibliographic entry see Field 3E.
W84-04779

INFORMATION AND RECOMMENDATIONS ON TOPICAL QUESTIONS CONCERNING WATER CONSERVATION BY MEANS OF SOIL TREATMENT WITH WASTEWATER (INFORMATIONEN UND EMPFEHLUNGEN ZU AKTUELLEN FRAGEN DES GEWASSERSCHUTZES DURCH ABWASSERBODENBEHANDLUNG),
D. Kramer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 120-121, April, 1983.

Descriptors: *Conferences, *Water conservation, *Wastewater irrigation, *Sludge disposal, Land disposal, Water pollution control, Advanced wastewater treatment, Nutrients, Water reuse, Fertilizers, Wastewater disposal.

The proceedings and conclusions of a conference on 'Effective Water Conservation By Means of Soil Treatment with Wastewater (WST) and Sewage Sludge Utilization in Crop Production' held in the German Democratic Republic are reported. WST has the potential of reducing pollution in surface waters, allowing utilization of secondary raw materials in the form of nutrients, and contributing considerably to rational water use by substituting wastewater for treated water in agricultural irrigation. Subjects of conference presentations included organizational problems in ensuring regular use of increasing amounts of wastewater and in guaranteeing operation during the winter, the meaning of WST as an advanced wastewater treatment method (especially for nutrient elimination), level of purification reached on agricultural land used by WST facilities for overflow (for average loads of 3,200 mm/yr a 4-yr period: 5-day BOD = 85-95%, phosphorus and nitrogen degradation of 99.5% and 58%, respectively), the influence of sprinkling with municipal wastewater on the yield of various fruits and on macro- and micronutrient concentrations in soil, and the type of WST facility to be used. Discussions on sewage sludge utilization included production and technological problems, the influence of sludge containing heavy metals on crop yield, and sludge use in manufacturing organic fertilizer. As a result of the conference proceedings, the following recommendations concerning future activities were made: regulations on the organization of WST facilities including progressive processes for wastewater treatment outside the growing season; establishment of scientific, technological, and economic data for WST control; capture of return flow from wastewater irrigation and its reuse for irrigation; studies in the influence of heavy metals in WST and sewage-sludge utilization; and utilization of sewage sludge in the national program for the increase of soil fertility. (Gish-IVI)
W84-04788

LYSIMETER STUDIES TO MEASURE WASTEWATER PURIFICATION LEVEL AND NUTRIENT CONCENTRATION IN PERCOLATED WATER (LYSIMETERUNTERSUCHUNGEN ZUR ABWASSERREINIGUNG UND NAHRSTOFFKONZENTRATION IM SICKERWASSER),
Forschungszentrum fuer Bodenfruchtbarkeit Muencheberg(German, D.R.).
For primary bibliographic entry see Field 3C.
W84-04792

5E. Ultimate Disposal Of Wastes

HYDROGEOLOGIC INVESTIGATION OF THE MAXEY FLATS RADIOACTIVE WASTE BURIAL SITE, FLEMING COUNTY, KENTUCKY,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W84-04244

SIMULATING THE HYDRAULIC BEHAVIOR OF A SEWAGE SLUDGE-AMENDED MINE SOIL,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W84-04464

GEOHYDROLOGY OF INDUSTRIAL WASTE DISPOSAL SITE,
United States Ecology, Inc., Louisville, KY.
R. K. Ganor.
Journal of Energy Engineering, Vol. 11, No. 1, p 10-21, March, 1984. 6 Fig, 2 Tab, 5 Ref.

Descriptors: *Industrial wastes, *Waste disposal, *Deserts, *Nevada, *Geohydrology, Groundwater barriers, Radioactive wastes, Hazardous wastes.

An existing desert site for hazardous chemical and low-level radioactive waste disposal is evaluated for suitability as an industrial waste disposal site. The site is characterized using geologic, geohydrologic, geochemical, and other considerations. Design and operation of the facility is considered. The site is located in the Amargosa Desert, which is a northwesterly trending valley between Bare Mountain and the Amargosa Mountain Range. The area consists of broad, flat valleys separated by rugged mountain ranges. The valley floor is formed of unconsolidated deposits of gravel, sand, silt, and clay derived from weathering of the mountains. The valley basement is assumed to be similar to the Paleozoic sedimentary and metamorphic rocks with Tertiary igneous intrusions, primarily basaltic and rhyolitic lavas and rhyolitic tuffs similar to the rocks exposed on Bare Mountain to the north. Five deep borings and several shallower ones have been drilled to determine site characterization, monitoring, and regulatory requirements. The average annual precipitation at Lathrop Wells is 2.5 in; that for Beatty is about 4.5 in. Potential evapotranspiration at the site is about 36 in/yr. Regionally the major ground water units are present in the interstices of the unconsolidated deposits in the valley floor and the upgradient alluvial fans. The regional gradient is determined to be on the order of 30 ft/mile and the general direction of flow is along the trend of the valley with the major recharge being effected by surface runoff at the base of the confining ridges. Recharge from the Amargosa and its tributaries is considered negligible. (Baker-IVI)
W84-04492

SIGNIFICANCE AND BEHAVIOUR OF HEAVY METALS IN WASTE WATER TREATMENT PROCESSES; II. SLUDGE TREATMENT AND DISPOSAL,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
For primary bibliographic entry see Field 5D.
W84-04748

5F. Water Treatment and Quality Alteration

IS METROPOLITAN TORONTO'S DRINKING WATER SAFE,
F. J. Horgan.
Water and Pollution Control, Vol. 122, No. 1, p 19-21 and 36, January/February, 1984.

Descriptors: *Water quality control, *Drinking water, *Toronto, *Ontario, Water pollution control, Guidelines, Potable water, Trihalomethanes.

Concern has been voiced over the quality of drinking water in Toronto mainly because of the much publicized situation along the Niagara River where chemical wastes were deposited for years before their potential hazard was known. Tests made on the drinking water have indicated that the organic and inorganic content of the water is much below the levels specified in the guidelines as being safe. The ability of laboratories and the equipment now used to detect impurities in the drinking water down to the ppt level has increased our awareness of the presence of trace amounts of pollutants, thus adding to the concern of the general public, even though these contaminants were present before but simply undetectable. Some of the cost factors associated with quality control of drinking water are discussed. (Baker-IVI)
W84-04207

RENOVATION OF STEAM ELECTRIC POWER PLANT COOLING TOWER BLOWDOWN FOR NON-POTABLE REUSE,
Rexnord, Inc., Milwaukee, WI. EnviroEnergy Technology Center.
R. Osantowski, J. Kane, and A. Geinopolus.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-153550, Price codes: A09 in paper copy, A01 in microfiche. Report RU-83/8, January, 1984. U.S. Bureau of Reclamation, Washington, DC. 165 p, 23 Fig, 26 Tab, 13 Ref, 1 Append. Project No. OWRT C-10054-R (1478) (1), Contract/Grant No. 14-34-0001-1478.

Descriptors: *Reverse osmosis, *Demineralization, Industrial wastes, Pilot plants, *Electrodialysis,

Recycling, Filtration, *Water reuse, Cooling tower blowdown, Water treatment.

Findings are presented of a nine month pilot plant study investigating non-potable reuse potential of electric power plant cooling tower blowdown. The two demineralizing technologies studied included reverse osmosis and electrodialysis. Pretreatment throughout the testing was performed using chemical softening/clarification and dual media filtration. During the investigation, about 4,000 operating hours were put on each of the two desalting technology membranes to obtain information on membrane life expectancy. The most promising treatment technologies which meet the make-up water quality requirements for reuse of the cooling tower blowdown in the tower recirculating water system, as determined by pilot treatment train performance, as discussed. Potential power plant water reuse applications have been identified along with the water quality and quantity requirements. Comparisons were then made to the treated blowdown quality achieved from each of the pilot process elements.
W84-04237

NEW WATERWORKS FOR THE REDEVELOPMENT OF BAGHDAD CITY, WITH PARTICULAR REFERENCE TO THE LARGE DIAMETER TRANSMISSION PIPELINES,
W. J. Carlyle.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 385-400, October, 1984. 5 Fig, 2 Tab.

Descriptors: *Pipelines, *Water transport, *Baghdad, *Iraq, Water supply, Water supply development, Water demand, Tigris River, Euphrates River, Dokan Reservoir, Mosul Reservoir.

Oil wealth has triggered a major urban redevelopment in Baghdad, including a completely new water supply and drainage system. This will comprise about 9000 km of transmission and distirbution water mains, together with new intake works, treatment works, storage reservoirs and pumping stations, and 9000 km of sewers and associated pumping stations and sewage treatment plants. A major development program calls for regulation of the Tigris and Euphrates rivers from a combination of upstream storage reservoirs, some of which, such as the Dokan reservoir, already exist, and others, such as the Mosul reservoir on the main Tigris, are under construction. The major element which will allow for complete regulation of both rivers is the storage capacity which has been created in the Tharthar depression between the two rivers. In most cases the river water provides a satisfactory source of raw water, with relatively good bacteriological quality. The new plants under construction or proposed will deal with excessive turbidity by two stage settlement, with polyeletrolyte dosing in the presettlement tanks to reduce the overall suspended solids. (Baker-IVI)
W84-04308

MALMESBURY GROUNDWATER SCHEME,
Wessex Water Authority, Bristol (England).
C. J. Swinnerton, and M. A. Hillyer.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 421-436, October, 1983. 6 Fig, 3 Append.

Descriptors: *Groundwater management, *Water supply development, *Malmesbury, *England, Planning, Management, Water demand, Water supply, Environmental effects, Flow augmentation.

The groundwater scheme at Malmesbury is discussed from identification through investigation, development, promotion, and operation. To identify the optimum strategy for the development of new sources to meet the future deficiencies all possible resource options were compared by means of a resource allocation and costing computer system. In order to reach water demand projections by the year 2011, an additional 56 Ml/d is required. The area of investigation embraced the entire surface water and groundwater catchments upstream of Great Somerford, on the river Bristol Avon, lying mainly in Wiltshire but with parts in Avon and Gloucestershire. The surface catchment is some 260 sq km, but the groundwater catchment is some 95 sq km larger since the groundwater divide lies inside the Thames surface water catchment. Specific investigations were made concerning agricultural considerations, environmental considerations, water quality, pumping tests, and effects of groundwater abstraction. The scheme will provide on average an additional 18 Ml/d of water for potable supply by direct supply and, within the overall proposals, provision is made to discharge up to 26 Ml/d of stream support water during times of low flow. (Baker-IVI)
W84-04310

DESIGN, CONSTRUCTION AND OPERATION OF TULLICH WATER TREATMENT WORKS, USING OZONE TREATMENT,
Cuthbertson (Robert H.) and Partners, Edinburgh (Scotland).
I. A. T. Gowans, and C. J. McFadzean.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 5, p 437-459, October, 1983. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Water treatment, *Ozonation, *Scotland, *Color, Peat, Disinfection, Tullich water works, Water treatment facilities.

Experience with the treatment process at Tullich over the past four years has shown that ozone can successfully be used to treat Scottish peat stain waters with colors up to 60 degree H. Three minor improvements could be made: material selection of the diffuser end caps and tie rods; sealing of access manhole covers to the ozone contact chambers; and inspection portholes should have been placed in all of the ozone contact chambers to check visually the ozone distribution pattern. Operationally there are no problems associated with the production of ozone provided that a dew point of minus 50 degrees C is maintained in the supply air to an ozonizer. The application of ozone to the water is a simple process to control, with color being the only parameter which an operator is required to monitor. (Baker-IVI)
W84-04311

THE EXPLOITATION OF POLLUTED WATERS FOR POTABLE SUPPLIES,
Binnie and Partners, London (England).
A. L. Downing, and F. W. Crowley.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 1, p 39-57, February, 1984. 3 Fig, 11 Ref.

Descriptors: *Water treatment, *Drinking water, *Potable water, *Water supply development, Conservation, Sulfates, Chlorides, Hardness, Heavy metals, Dissolved organic matter, Cost analysis.

In many parts of the world keeping pace with rising demands for water often requires exploitation of sources of relatively poor quality. To decide the most cost-effective policy, options must be compared in quantitive terms. Some of the factors to be considered are: the means and costs of treating wastewaters and abstracted water to given standard; the effects of pollution on the quality of natural waters; and the relationship between the quality of raw and treated waters and their suitability for given uses. Information is given on water quality criteria and standards for potable supply; and current problems including non-biodegradable organic matter, algae, chlorides, sulfates, hardness and heavy metals. The treatability of polluted raw waters is described with examples offered of Bedok Catchment, Singapore; Lough Neagh, Northern Ireland; Camiri, Bolivia; and the Swan/Avon Tributaries in Perth, Australia. Cost information on the treatment of difficult waters as described is also considered. (Baker-IVI)
W84-04319

TREATMENT OF ARSENIC(V)-CONTAINING WATER BY THE ACTIVATED CARBON PROCESS,
Delaware Univ., Newark. Coll. of Urban Affairs and Public Policy.
C. P. Huang, and P. L. K. Fu.
Journal Water Pollution Control Federation, Vol. 56, No. 3, p 233-242, March, 1984. 16 Fig, 4 Tab, 45 Ref.

Descriptors: *Arsenic, *Activated carbon, *Water treatment, Adsorption, Acidity, Regeneration, Drinking water, Organic compounds.

Arsenic removal characteristics of some commercial activated carbons were investigated with emphasis on important parameters such as carbon type, pH, and total arsenic concentration. The regeneration of arsenic-laden activated carbon was also studied. Of the 15 different brands of commercial activated carbon tested, two, D-X and D-XI, seemed to be the most effective. Maximum As(V) removal occurred at pH 4 to 5. Electrostatic attraction and the formation of specific chemical bonds were the major adsorption mechanisms. This was evident from the reversal of surface charge on As(V) adsorption. Treatment with these activated carbons met drinking water standards. The presence of oganics such as Tiron had no effect on As(V) removal. The presence of Fe(II) drastically increased both the rate and the extent of As(V) removal. Treating As(V)-laden activated carbon with strong acid or base effectively stripped off adsorbed As(V) species. However, As(V) adsorption was not restored by strong acid or base treatment. The As(V) adsorption capacity of the strong acid or base treated activated carbon was greatly improved by further treatment with Fe(III) salts. (Baker-IVI)
W84-04324

OZONATION AND OXIDATION COMPETITION VALUES; RELATIONSHIP TO DISINFECTION AND MICROORGANISMS REGROWTH,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
K. Bancroft, P. Chrostowski, R. L. Wright, and I. H. Suffet.
Water Research, Vol. 18, No. 4, p 473-478, 1984. 6 Fig, 3 Tab, 24 Ref. EPA grant CR806256-02.

Descriptors: *Ozonation, *Oxidation, *Disinfection, *Delaware River, *Pennypack Creek, *Schuylkill River, *Wissahickon Creek, *Philadelphia, *Pennsylvania, Bacterial growth, Water treatment, Microorganisms, Organic carbon.

This study was conducted to determine the role of oxidation competition value (omega) in an ozone disinfection process and to evaluate the potential bacterial growth capacity of water as a result of ozonation. The omega value is a measure of the competition for ozone by a reference solution and the total organic matter present in the water sample. Water samples for this study were taken from various sites in the Philadelphia area including the Delaware River, Schuylkill River, Pennypack Creek and Wissahickon Creek. Ozonation was carried out using a Welsbach T408-ozonator. Good correlations were obtained between TOC, omega and three measures of microbial inactivation (90% kill, 50 degrees kill and breakpoint). The amount of ozone applied that was required to obtain each of the inactivation parameters was greater when the TOC and omega values of the water were higher. The amount of ozone required to obtain these parameters was independent of initial bacterial density. Initial death rates were related to the quantity of ozone applied. While ozonation may result in a reduction of TOC concentration, the results using Delaware River water indicated the capacity for potential regrowth of microorganisms may be enhanced. (Moore-IVI)
W84-04354

PARTICLE FORMATION AND GROWTH IN DILUTE ALUMINUM (III) SOLUTIONS; CHARACTERIZATION OF PARTICLE SIZE DISTRIBUTIONS AT PH 5.5,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass, M. M. Clark, and C. R. O'Melia.
Water Research, Vol. 18, No. 4, p 479-488, 1984. 8 Fig, 2 Tab, 13 Ref. EPA grant R-808104.

Descriptors: *Aluminum, *Water treatment, *Particle size, Fulvic acids, Humic substances, Color, Turbidity, Ionic strength, Hydrogen ion concentration.

Aluminum salts are widely used as coagulants in water treatment to remove turbidity and color. The removal of humic substances is currently receiving much attention because they have been identified as precursors for potential carcinogens formed by reactions with chlorine. The humic materials used in this research are fulvic acids, the predominant form of humics in surface waters. Particle formation and growth over the 1-40 micro m size range in dilute aluminum solutions (approx. 0.0002 M) was studied using an electronic particle counter. Sulfate, fulvate and hydroxide ion accelerate the rate of particle formation and changes of the particle size distribution over time. Increasing ionic strength (inert electrolyte) produces similar but less dramatic effects. Combinations of sulfate and fulvic acid or sulfate and inert electrocyle further accelerate the rate of particle formation. Aluminum chloride solutions at moderate ionic strength are devoid of supramicron particles after several days. A conceptual pathway model is developed which suggests that two different solids are formed when aluminum is added to fulvic acid solutions: an aluminum-fulvate precipitate and Al(OH)3(s). The first solid dominates in fulvic acid solutions at pH about 5.5. The model stresses the role of sulfate in aluminum polymer formation and in the formation of both solids. It views the role of pH as being an important controller of particle formation; the role of ionic strength is viewed as secondary in importance. (Moore-IVI)
W84-04355

DISSOLVED ORGANIC MATTER AND THE DISSIPATION OF CHLORINE IN ESTUARINE WATER AND SEAWATER,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. T. F. Wong, and T. J. Oatts.
Water Research, Vol. 18, No. 4, p 501-504, 1984. 3 Fig, 1 Tab, 18 Ref. DOE grant EE-77-S-05-5572.

Descriptors: *Chlorination, *Organic matter, *Estuarine water, *Seawater, *James River, *Virginia, *Chesapeake Bay, Molecular weight, Organic carbon, Chlorine demand.

Dissolved organic matter in estuarine water and seawater collected in the summers of 1980 and 1981 in the James River, Virginia and the mouth of Chesapeake Bay were separated into fractions according to their nominal molecular weights (NMW) by ultrafiltration. Estuarine waters contained higher concentrations of dissolved organic carbon (DOC). Among the fractions, between 66-89% of the DOC was found in the fraction with NMW below 10,000. Estuarine waters also had higher chlorine demands. At a dose of 5 mg/l, in 23 h, about 90% of the added chlorine disappeared in estuarine waters, whereas, in seawater, only 60-75% of the chlorine had dissipated. At least two-thirds of the chlorine demand occurred in the first 5 h. About 10-30% of the chlorine demand may be attributed to the fraction with NMW about 10,000. The remaining chlorine demand was distributed almost equally between the fractions with ranges of NMW of 1000-10,000 and below 1000. If reactivity is measured in terms of organic chlorine demand (delta Clo) per unit weight of DOC, the fractions with lower NMW (less than 1000 and 1000-10,000) always had a higher reactivity towards chlorine. Between these two fractions, the one with NMW between 1000 and 10,000 exhibited higher reactivity more frequently. The highest reactivity found was 1.4 mg delta Clo/mg DOC. (Author's abstract)
W84-04356

EXPERIENCE IN MONITORING DOMESTIC WATER SOURCES AND PROCESS WATERS FOR TRACE ORGANICS,
South Dakota School of Mines and Technology, Rapid City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W84-04387

GEOLOGY AND THE WATER SUPPLY IN THE AREA OF THE FORMER DUCHY OF NASSAU (GEOLOGIE UND WASSERVERSORGUNG IM GEBIET DES FRUHEREN HERZOGTUMES NASSAU),
W. Stengel-Rutkowski.
Jahrbucher des Nassauishcen Vereins fur Naturkunde, Vol. 106, No. 1, p 14-26, 1983. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Water supply, *Water supply development, Reservoirs, Groundwater, History, Water resources development, West Germany.

The history of the development of a water supply network in the area previously known as the Duchy of Nassau, Federal Republic of Germany (FRG), is described in relation to its geology. The area is bordered on the west and south by the Rhine and Main rivers, respectively, and covers about 4,700 sq km. It consists largely of the East Rhine slate mountains, which are predominantly clayey and sandy slate with low permeability: despite high precipitation, the area has one of the smallest groundwater supplies in the FRG. Adequate supplies are present in the basalt Westerswald, the Limburg basin, and the lower Main plain. Before and during the time of the Duchy, rivers and streams were the main source of water, supplemented by shallow groundwater wells; only certain towns had water supply systems (e.g., provision of spring water to Weilburg via suspension bridge in 1784). The water supply only became a problem in the Prussian era with higher standards of hygiene and the industrial revolution. Central systems were constructed between 1890 and 1914; significant were the four Wiesbaden shafts for groundwater extraction from the Taunus range and the advent of water towers. All districts could be included only with the development of pump technology and energy networks. During the 1960's, well-drilling technology improved, and disused mine working became groundwater collectors as demand increased, while in the 70's, small districts began to form combined water organizations. Water importing grew in significance. Water quality standards also improved, resulting in increased treatment of groundwater whose quality had decreased with industrialization and its associated pollution. This led to the formation of water conservation areas. Since groundwater supplies are inadequate, the future must bring development of surface water resources, including dam construction in the Taunus to provide drinking water reservoirs. Water importing will remain significant. (Gish-IVI)
W84-04403

WATER MANAGEMENT,
P. Millington.
Process Engineering, Vol. 65, No. 3, p 55 and 57, March, 1984.

Descriptors: *Computers, *Automation, *Water supply, Water management, Planning, Training, England.

In order for automation to be successful in water management concerns, much education remains to be done for operators and managers of the automatic instrumentation. They must learn to accept the new disciplines and use the systems provided. At least 5 of the 10 United Kingdom water regions have introduced automation in one form or another and others are giving it careful thought. One recent installation within the Thames Water Authority is at the Deptford group of pumping stations. The group provides over 400,000 consumers with an average of 80 megaliters of water per day. The control center at Deptford has been equipped with a Microtel 700 microprocessor-based telemetry and telecontrol system. A network of outstations is linked to a Cromos central station. In Yorkshire water quality analytical instrumentation has been placed into the water authority's evaluation and demonstration facility. Whether automation of water management is to be successful in the long term depends not so much on the computer and the system as on the people operating it. Training is essential. (Baker-IVI)
W84-04413

APPROPRIATE MINERAL CONTENT OF DESALINATION WATER - THEORY AND DRINKERS' REACTION. PART I,
Italimpianti of Australia Pty Ltd., Sydney.
For primary bibliographic entry see Field 3A.
W84-04557

STUDIES ON HOME WATER TREATMENT SYSTEMS,
Environmental Protection Agency, Washington, DC.
F. A. Bell, Jr., D. L. Perry, J. K. Smith, and S. C. Lynch.
American Water Works Association Journal, Vol. 76, No. 4, p 126-130, April, 1984. 1 Fig, 7 Tab, 6 Ref.

Descriptors: *Drinking water, *Water treatment, Endotoxins, Efficiency, Trihalomethanes, Organic compounds, Water quality control, Organic compounds, Chlorinated hydrocarbons, Microorganisms, Groundwater, Surface water.

Commercially available home water treatment systems were tested to compare the efficiency of more than 30 units in removing volatile organic chemicals and to investigate the microbiological and endotoxin concentrations found in the filter effluents. Statistical information on every unit tested is presented in a series of tables. Units were of various types including faucet bypass, pour-through, stationary, and line bypass. Data is listed concerning trihalomethane and nonpurgeable total organic carbon reductions, average trihalomethane reduction efficiencies by type of commercial unit, statistical comparison of standard plate count and endotoxin data from test unit effluent and control loop samples - groundwater study, summary performance for halogenated organics removal during rated lifetime of units in the groundwater study, range of percentage reduction of specific halogenated organics (carbon tetrachloride, 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene) in groundwater studies, and the range of percentage reduction of specific halogenated organics (p-dichlorobenzene, hexachlorobenzene, and chlordane) in a surface water study. (Baker-IVI)
W84-04580

BORON CONTROL IN POWER PLANT RECLAIMED WATER FOR POTABLE REUSE,
Raymond Kaiser Engineers, Inc., Oakland, CA.
For primary bibliographic entry see Field 5D.
W84-04628

EXACTING DEMANDS OF THE 1983 PEOPLE'S ECONOMIC PLAN ON WATER INDUSTRY PERSONNEL MUST BE FULFILLED WITH HONOR (HOHE ANFORDERUNGEN DES VOLKSWIRTSCHAFTSPLANES 1983 AND DIE WASSERWIRTSCHAFTLER IM KARL-MARX-JAHR EHRENVOLL ERFULLEN),
H. Reichelt.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 75-77, March, 1983.

Descriptors: *Water supply, *Utilities, *East Germany, Water law, Water demand, Water conservation, Water pollution control, Industrial water, Wastewater treatment, Water use.

Goals for the water industry in the German Democratic Republic for 1983 were set at the Fifth Conference of the Central Committee of the German Socialist Unity Party. The 1983 plan must be implemented in conjunction with the new water law of 7/2/1982. A stable water supply is the central aim, particularly as the long drought of 1982 left unfavorable conditions in many reservoirs and ground water supplies. Rational water used is the keystone of the plan; this consists mainly of elimination of wastage, reductions in water losses, in specific water requirement per product unit in industry, in water use in high-demand areas, and in pollution (through reclamation of valuable substances found in wastewater, increased effectiveness of existing wastewater treatment facilities, and the construction of new ones), decreased use of

drinking water for industrial purposes, and the diversion of drinking water from industrial waterworks into the public supply. The economic strategy required to put these measures into practice comprises higher productivity and a corresponding decrease in materials, energy use, and funding. Productivity must increase by 4.4% in the Water Supply and Wastewater Treatment (WSWT) division and by 3.8% in Water Management. Water demand must increase by no more than 0.8%, and specific industrial demand must decrease by at least 5%. WSWT is expected to save 14.8 million cu m/yr drinking water by reducing water loss, while industry and other high users should save 7 million cu m/yr. Work and living conditions for workers will continue to be improved: at least a further 1,200 jobs will be reorganized and manual labor will be reduced. (Gish-IVI)
W84-04778

MODEL STUDIES ON PREVENTIVE MEASURES AGAINST DAMAGE BY POLLUTANTS AT BANK FILTRATE INSTALLATIONS (MODELLUNTERSUCHUNGEN ZU VORBEUGENDEN MABNAHMAN GEGEN SCHADSTOFFHAVARIEN AN UFERFILTRATFASSUNGEN),
H. J. Diersch, and P. Nillert.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 103-107, March, 1983. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Filtration, *Water treatment, Water pollution effects, Mathematical models, Groundwater pollution, Groundwater recharge, Pollution load, Raw water.

Construction of bank filtrate installations as two parallel galleries along the bank rather than a single gallery results in several advantages: a balancing of sudden appearances of peak pollutant loads with undiminished conveyance capacity, further reduction of pollutant concentration by selective use of galleries, and prevention of forseeable pollution damage through individualized gallery design. Mathematical models were constructed to describe the flow and migration transport of matter processes in two-gallery installations of various dimensions. The processes are seen as a binary system comprising two miscible chemical components: the dissolvable substance (pollutant) and the solvent (water) and are described by connected nonlinear differential equation systems. Variable parameters were distance between galleries (e), duration of pollutant inflow, and migration parameter of dispersion. Results showed that the two-gallery design reduced peak levels of pollutants, especially when separate utilization of raw water from well B in the gallery further from the bank occurred; that the optimal design (i.e., significant peak level reduction without significant increase of pollutant inflow duration) was with e = 50 m (also = distance between wells, which were placed alternately on each gallery), when a 50% peak level reduction with a 19% duration increase occurred at well B; and that this design makes possible a nonuniformly greater range of variation for the prevention of supercritical pollution loads in the raw water. However, the two-gallery systems has no effect on pollutants that can be accumulated by the end user regardless of their concentration, since it does not eliminate these, only reduces their concentration. The design can also be used for groundwater enrichment facilities and may be applied not only for new installations but also in the rebuilding of old ones. (Gish-IVI)
W84-04784

ALGAL BLOOM OF THE FLAGELLATE SYNURA UNVELLA IN THE KLINGENBERG AND LEHNMUHLE DRINKING WATER RESERVOIRS - ITS EFFECTS ON THE DRINKING WATER SUPPLY AND ITS TREATMENT (DIE MASSENENTWICKLUNG DER GEIBELALGE SYNURA UVELLA IN DEN TRINKWASSERTALSPERREN KLINGENBERG UND LEHNMUHLE - IHRE AUSWIRKUNGEN AUF DIE TRINKWASSERVERSORGUNG UND IHRE BEKAMPFUNG),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
K. Putz, J. Benndorf, H. Glasebach, and G. Kummer.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 135-138, April, 1983. 4 Fig, 5 Ref.

Descriptors: *Drinking water, *Dresden, *Freital, *East Germany, *Eutrophication, Synura, Reservoirs, Solar radiation, Water treatment, Activated carbon, Aluminum sulfate, Calcium hydroxide, Hydrogen ion concentration, Nutrients, Water pollution control, Algae.

In Spring 1982 a strong fishy and oily odor and taste appeared in the drinking water in part of the city of Dresden and in Freital, German Democratic Republic. This was due to an unprecedented algal bloom of Synura uvella in the Klingenberg (K) and Lehnmuhle (L) reservoirs. The algae were able to develop because of high light levels in the reservoirs in February (21 sunny days, double the usual, and a snow-free ice cover) and insufficient circulation after the March thaw. At the Coschutz waterworks, 30 g/cu m activated carbon was added and aluminum sulfate was increased from 2 to 10 g/cu m. At the K waterworks, activated carbon could not be used for technological reasons; aluminum sulfate was also increased to 10 g/cu m to no effect. The entire catchment area is a water conservation area; official agencies were charged with reducing nutrient inflow into the reservoirs, particularly by banning wastewater from a dairy. At K, raw water was taken from a new level, but this was unsuccessful, as the mobile algae were found at all depths. At the time of the bloom, 50% of total phosphorus inflow at K came from L, so all inflow from L was stopped on 3/11/82. Application of 5 mg/l calcium hydroxide raised pH to 9-10 and eventually killed the algae in test samples; this dosage was begun at K on 4/3 and ended on 4/4. The peak effect was found on 4/7 when pH was 8.3-9.2 and almost all algae were dead. By 4/9 drinking water quality was restored. L served as a control to show that the demise of the algae was not due to chance. (Gish-IVI)
W84-04791

5G. Water Quality Control

USE OF LINERS FOR CONTAINMENT AT HAZARDOUS WASTE LANDFILLS,
EMCON Associates, San Jose, CA.
For primary bibliographic entry see Field 8G.
W84-04201

GROUNDWATER PLAN SIDESTEPS CONTAMINATION WOES,
Lexington-Fayette Urban County Government, KY.
S. M. Kilner.
Water Engineering and Management, Vol. 131, No. 3, p 27-29 and 32-34, March, 1984.

Descriptors: *Groundwater management, *Water pollution control, Aquifers, Management, Water management, Water quality, Legislation, Groundwater pollution.

Municipal planners, health officials and water superintendents should modify their management practices and regulations now to protect groundwater supplies from contamination, rather than waiting until more standards are developed and testing abilities improve. Local officials can initiate protective measures by prepairing an aquifer protection plan for their community or region. An aquifer protection plan should outline a strategy for protection of the drinking water source and provide necessary backup information for the various municipal agencies responsible for its implementation. In order to prepare such a strategy, the lead agency should review existing information on the quality of the municipal drinking water, locate potential contaminant sources, identify remedial measures and protection strategies, evaluate existing regulations and management practices, and propose amendments or new measures where appropriate. (Baker-IVI)
W84-04205

IRON SPECIATION IN ACID MINE EFFLUENTS: CHEMICAL AND MICROBIAL CONTROLS,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W84-04230

A WATER HANDBOOK FOR METAL MINING OPERATIONS,
Colorado School of Mines, Golden. Dept. of Chemistry and Geochemistry.
For primary bibliographic entry see Field 5B.
W84-04233

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Dept. of Business Environment and Policy.
For primary bibliographic entry see Field 6E.
W84-04234

WATER QUALITY MANAGEMENT DECISIONS ON TWO OKLAHOMA STREAMS,
Corps of Engineers, Tulsa, OK.
R. C. Hunter, J. H. Carroll, and J. C. Staves.
Journal of the Water Pollution Control Federation, Vol. 56, No. 3, p 274-279, March, 1984. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Planning, *Evaluation, *Water quality management, *Oklahoma, East Cache Creek, Cow Creek, Economic aspects, Water pollution control, Flow augmentation, Dissolved oxygen, Regulations, Wastewater treatment facilities, Decision making.

Decisions involved in constructing a flow augmentation system for two Oklahoma streams, and illustrations of how extraneous factors abolished the need for such augmentation between the planning and implementation phases are discussed. The methodology used to determine the probable effects of flow augmentation and the associated costs are shown. Initial planning for the changes began in 1961. Between 1963 and 1980 some major changes influencing pollution loads in both the East Cache Creek and Cow Creek basins occurred including the construction of an advanced wastewater treatment plant in Lawton, the expansion and upgrading of the Ft. Sill wastewater treatment plant, population growth in the area which failed to meet the earlier predictions, a reduction in the Oklahoma dissolved oxygen standards, and dramatic increases in fuel costs leading to increased costs for pumping the flow augmentation water. A re-study of the decision was undertaken in 1981. In the final analysis, if the original course of action had been followed, it would have resulted in unnecessary annual costs of $972,000 for 18 years for a total of $1,524,000. The study also showed that efforts to improve the aquatic environment have been effective. The need for flow augmentation was eliminated, particularly in the East Cache Creek basin. Many other projects planned or implemented during the 1960s and early 1970s might be profitably re-evaluated in term of recent improvements in environmental quality. (Baker-IVI)
W84-04327

PHOSPHORUS REMOVAL IN A SEWAGE TREATMENT PLANT AND PLANT BIOMASS IN AN EFFLUENT RECEIVING LOWLAND STREAM,
East Brabant Dept. of Technology, Boxtel (Netherlands).
For primary bibliographic entry see Field 5D.
W84-04378

ESTABLISHMENT AND MANAGEMENT OF FRESHWATER MARSHES FOR MAXIMUM ENHANCEMENT OF WATER QUALITY FOR REUSE,
Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton, and K. E. Ulrich.
Available from the National Technical Information Service, Springfield, VA 22161, as PB84169390, Price codes: A04 in paper copy, A01 in microfiche.

Completion Report, September, 1983. 65 p, 22 Fig, 8 Tab, 44 Ref. Project No. OWRT B-055-MICH(1), Contract/Grant No. 14-34-0001-0267.

Descriptors: Marshes, *Wetlands, Municipal wastewater, Storm wastewater, *Cycling nutrients, *Marsh plants, *Wastewater renovation, Wastewater treatment, Phosphorus, Nitrogen, Potassium, Phragmites, Zizania, Typha, Sparganium, Spartina, Elodea, Plant growth.

The objective of this study was to provide information (1) on growth and nutrient uptake responses of marsh plants to variable loading rates of N, P, and K and (2) on the response of these plants to various harvest regimes as background information for the design, maintenance, and operation of natural or artificial marshes for water quality enhancement. Five species of highly productive common marsh plants were grown in large pots with various loading rates of nitrogen, phosphorus, and potassium plus an excess of other necessary plant nutients. The five species were the common reed (Pragmites australis), wild rice (Zizania aquatic), two species of cattail (Typha latifolia and T. angustifolia), and burreed (Sparganium eurycarpum). In general, all five species responded with increased growth to increases of N and P alone or especially in combination up to a maximum of 468 N/ha and 125 kg P/ha. Growth of S. eurycarpum was inhibited at loading rates of 936 kg N/ha. The two species of cattail were the most productive of the five species at higher loading rates. The potassium contained in the low nutrient and medium used in these experiments was adequate for growth of all species, and added K caused little or no increase in growth. Experiments on establishment and harvest of these five species plus prairie cordigrass (Spartina pectinata) were attempted. Successful establishment and harvest of the two species of cattail and burreed was achieved. These three species only tolerated one harvest per year; multiple harvesting led to decline in biomass the following year. Nutrient budgets for three 0.47 artificial marshes indicated excellent removal of N by these marshes, but little P removal occurred.
W84-04409

EFFECTS OF ANURAN LARVAE ON AQUATIC PROCESSES ASSOCIATED WITH WATER QUALITY,
New Hampshire Univ., Durham. Water Resources Research Center.
J. T. Taylor, and C. Duerring.
Available from the National Technical Information Services, Springfield, VA 22161, as PB84163161, Price codes: A04 in paper copy, A01 in microfiche. Research Report 42, July, 1983. 50 p, 12 Fig, 6 Tab, 28 Ref. Project No. OWRT A055-NH(2), Contract/Grant No. 14-34-0001-2131.

Descriptors: *Anuran larvae, *Cyanobacteria, Sedimentation, *Decomposition, Water clarity, *Eutrophication, Algal control, Water quality, Water pollution control, Water pollution effects, Sediments.

Laboratory and field experiments and field observations were conducted to assess the role of native anuran larvae in several ecosystem processes associated with water quality. The impacts were investigated of these animals on populations of problem-causing toxic cyanobacteria, on rates of sedimentation and water clearing, on rates of decomposition of sediments and on export of biomass from aquatic to terrestrial systems. Anuran larvae were killed by intraperitoneal injection of the toxic cyanobacteria Aphanizomenon flosaquee and Anabaena flosaquae, but were unaffected by injections of Anacystic aeruginosa. All three species of cyanobacteria were effectively ingested by anuran larvae without ill effects; the filimentous forms were quickly exterminated from experimental chambers. Cyanobacteria were not a good ration for the larvae, as they lost weight rapidly on a diet of pure cyanobacteria. Anuran larvae were extremely effective at removing suspended sediments (tripton) from the water column, increasing light transmission through water much more rapidly than would occur through physical settlement. Sediments (tripton) from the water column, increasing light transmission through water much more rapidly than would occur through physical settlement. Sediments processed by anuran larvae and released as feces decomposed much more rapidly than unprocessed sediments. These results suggest that anuran larvae could have major effects on algal blooms, water clarity, and decomposition rates.
W84-04410

STRATEGIES FOR SALINITY CONTROL FOR THE UPPER COLORADO RIVER BASIN,
R. G. Evans, W. R. Walker, and G. V. Skogerboe.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 3, p 738-742 and 747, May-June, 1983. 5 Fig, 2 Tab, 17 Ref.

Descriptors: *Salinity control, *Upper Colorado River Basin, *Cost analysis, Canals, Laterals, On-farm improvements, Optimization, Water pollution control, Water quality control.

A multi-level nonlinear optimization procedure was utilized to develop an array of strategies for the most cost-effective salinity control program for the Upper Colorado River Basin. Cost effectiveness functions were developed for each point source control project for the major canals, aggregate laterals and selected on-farm improvements in each agricultural area designated in Public Law: 93-320. Marginal cost analysis showed that a cost-effective Upper Basin salinity control program would cost $30 million annual and remove 1.2 million megagrams of salt each year. Sensitivity analysis indicated that very large errors in costs and component salt contributions would have to be evident to change the order of the optimal salinity strategy. The results quantitatively indicate the location and general types of alternatives to be implemented and the associated annual costs for any selected level of basin-wide control. (Author's abstract)
W84-04434

DEWATERING DREDGED SEDIMENT FOR AGRICULTURE,
Illinois Univ. at Urbana-Champaign. Dept. of Agronomy.
For primary bibliographic entry see Field 4A.
W84-04444

COMPARISON OF RUNOFF QUALITY FROM CATTLE FEEDING ON WINTER PASTURES,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 5B.
W84-04460

MODELING DAIRY WASTE MANAGEMENT SYSTEMS' INFLUENCE ON COLIFORM CONCENTRATION IN RUNOFF,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
J. A. Moore, M. E. Grismer, S. R. Crane, and J. R. Miner.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1194-1200, July-August, 1983. 1 Fig, 8 Tab, 55 Ref.

Descriptors: *Waste treatment, *Dairy industry, *Runoff, *Coliforms, Animal wastes, Waste management, Land application, Water pollution control, Watersheds, Bacteria.

A model is presented which is based upon a mass balance where the effects of significant factors on bacteria populations are quantified and summed for a specific time increment. These factors include number of cows in the herd, type, capacity and management of waste storage unit, bacterial die-off in storage, waste application method and rate, bacterial die-off on the surface, precipitation, infiltration of water and bacteria, and finally, transport. The information gathered from application of the model suggests the following facts for minimizing the bacterial pollution potential of land-applied dairy wastes. Storage will markedly decrease pollution of surface waters. Drainlines will reduce runoff volume and the transport of bacteria. Spreading wastes on well-draining soils in the winter helps to decrease pollution potential. Buffer zones are an effective waste management procedure in reducing the quantity of pollution entering streams. Heavy application rates of wastes increase pollution potential. Runoff from barnyards laden with stacked animal wastes possesses the greatest pollution potential. (Baker-IVI)
W84-04461

REGULATING HAZARDOUS CHEMICALS IN AQUATIC ENVIRONMENTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns, Jr.
Boston College Environmental Affairs Law Review, Vol. 11, No. 1, p 1-10, 1983. 1 Fig, 25 Ref.

Descriptors: *Regulations, *Hazardous materials, Decision making, Aquatic environment, Water quality control, Environmental effects.

Current regulatory and scientific approaches to the presence of hazardous substances in an aquatic environment are examined. Implementation of a specific hazard evaluation process is recommended to ameliorate the inadequacies of present approaches. Evidence is overwhelming that the unmanaged environment cannot always assimilate or recover from anthropogenic stresses including toxic wastes, surface mining and acid rain. Solutions to the major problems require the collaboration of a diverse array of disciplines that are typically isolated from each other and unaccustomed to substantive interactions. The reemergence of integrative science characteristic of the period before the era of specialization is essential. The essence of the information learned must be communicated to laymen, used to make decisions, and incorporated into useful regulations. (Baker-IVI)
W84-04532

DEVELOPMENT OF A NATIONAL GROUNDWATER PROTECTION POLICY,
For primary bibliographic entry see Field 6E.
W84-04533

ST. JOHN'S HARBOUR WATER QUALITY MODEL,
Gore and Storrie Ltd., Toronto (Ontario).
R. J. Dewey, and M. D. Palmer.
Canadian Journal of Civil Engineering, Vol. 11, No. 1, p 65-73, March, 1984. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *St. John's Harbor, *Water quality model, Model studies, Water quality, Computer models, Water currents, Water level, Hydrologic models Management planning, Project planning.

At St. John's Harbor, Newfoundland, the city wants to enhance the water quality of this historic harbor by a staged capital works program over a period of years. A dynamic two-dimensional numerical water quality model was developed to assist in providing direction for a water quality enhancement program. The model input parameters were adjusted until the model outputs of water levels, currents, and water quality concentrations matched collected field data which included measurements of the sewer discharges. The tidal stage for the most degraded harbor water quality was identified. This stage was used to compare the harbor water quality enhancements and degradations for different management scenarios which included combining and relocating discharges, partial treatment of some discharges, and some direct ocean discharge. By using the model in a comparative manner, the requirements for model verification are reduced as are some of the errors in the modelling process. (Murphy-IVI)
W84-04550

AQUIFER RECLAMATION DESIGN: THE USE OF CONTAMINANT TRANSPORT SIMULATION COMBINED WITH NONLINEAR PROGRAMING,
Geological Survey, Reston, VA.
S. M. Gorelick, C. I. Voss, P. E. Gill, W. Murray, and M. A. Saunders.

Water Resources Research, Vol. 20, No. 4, p 415-17, April, 1984. 8 Fig, 4 Tab, 44 Ref. NSF grant CS-8012974.

Descriptors: *Aquifer reclamation, *Contaminant transport Simulation, *Nonlinear programming, simulation analysis, Model studies, Optimum development plans, Optimization, Reclaimed water, Groundwater pollution, Water pollution treatment, Water quality management, Groundwater management.

A simulation-management methodology is demonstrated for the rehabilitation of aquifers that have been subjected to chemical contamination. Finite element groundwater flow and contaminant transport simulation are combined with nonlinear optimization. The model is capable of determining well locations plus pumping and injection rates of groundwater quality control. Examples demonstrate linear or nonlinear objective functions subject to linear and nonlinear simulation and water management constraints. Restrictions can be placed on hydraulic heads, stresses, and gradients, in addition to contaminant concentrations and fluxes. These restrictions can be distributed over space and time. Three design strategies are demonstrated for an aquifer that is polluted by a constant contaminant source: they are pumping for contaminant removal, water injection for in-ground dilution, and a pumping, treatment, and injection cycle. A transient model designs either contaminant plume interception or in-ground dilution so that water quality standards are met. The method is not limited to these cases. It is generally applicable to the optimization of many types of distributed parameter systems. (Author's abstract)
W84-04565

APPLICATION OF STOCHASTIC DISSOLVED OXYGEN MODEL,
Gore and Storrie Ltd., Toronto (Ontario).
R. J. Dewey.
Journal of Environmental Engineering, Vol. 110, No. 2, p 412-429, April, 1984. 9 Fig, 2 Tab, 21 Ref.

Descriptors: *Dissolved oxygen, *Model studies, *Stochastic process, Mathematical models, Water pollution control, Water quality control, Pollution load, Receiving water.

A stochastic dissolved oxygen river model is developed based on modifications of a set of random differential equations after Streeter and Phelps. The method uses randomly generated rate constants and input parameters which are described by probability distributions determined from survey data means and their standard deviations to generate the probable dissolved oxygen levels in a river. The model is used to predict the effect of wastewater loadings from water pollution control plants on the dissolved oxygen level in the receiving river. The model is applied to the Thames River, London, Ontario, to determine if flow augmentation would reduce the number of episodes of low dissolved oxygen in the river during the low flow seasons. In addition, the model was used to test if improved treatment in the water pollution control plants would alleviate the low dissolved oxygen level in the river. The model results indicate that flow augmentation is not required if the water pollution control plants produce improved effluent. (Author's abstract)
W84-04598

INTERACTIVE WATER QUALITY SIMULATION IN A REGIONAL FRAMEWORK: A MANAGEMENT ORIENTED APPROACH TO LAKE AND WATERSHED MODELING,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 2A.
W84-04671

ECOLOGICAL EFFECTS OF LIME TREATMENT OF ACIDIFIED LAKES AND RIVERS IN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
F. Eriksson, E. Hornstrom, P. Mossberg, and P. Nyberg.
Hydrobiologia, Vol. 101, No. 1/2, p 145-164, April, 1983. 18 Fig, 10 Tab, 57 Ref.

Descriptors: *Ecological effects, *Lime treatment, *Acidic lakes, *Acidic streams, *Sweden, Acidic water, Lime, Phytoplankton, Macrophytes, Zooplankton, Benthos, Fish, Lake restoration, Biological properties.

Effects on the aquatic biota of lime (CaCO3) application in acidified lakes and streams were studied in a number of waters. After treatment, lime-sensitive species of mosses (Sphagnum spp.) decreased, but species such as Potamogeton natans and Myriophyllum alterniflorum seemed to be favoured. A few years after liming species composition and diversity of phytoplankton, zooplankton and benthic insect larvae were almost identical to that found in oligotrophic and non-acid lakes. Mollusks and benthic crustaceans may have difficulties recolonizing. Reproduction of remaining species of fish was successful as soon as pH increased. High survival of larvae and fry can result in some extremely rich year classes with slow individual growth. In most cases restocking of depleted fish stocks was successful. (Author's abstract)
W84-04709

ECOLOGICAL CLASSIFICATION OF THE QUALITY OF CONTINENTAL SURFACE WATERS,
Limnologicheskii Inst., Irkutsk (USSR).
V. V. Cherepanov.
Hydrobiological Journal, Vol. 19, No. 2, p 43-45, 1983. 5 Ref.

Descriptors: *Water quality, *Standards, *USSR, Decision making, Lakes, Streams, Water use, Surface waters.

A critical appraisal of the ecological classification of the water quality standard as proposed by Zhukinskiy and Oksiyuk (1976, Gidrobiol. 12(6):103-111) is presented. Zhukinskiy et al. have suggested five grades of water quality. They also have suggested nine finer gradations. The current authors take exception to the standard as proposed, suggesting that the quality of water can be classified only in terms of the requirements of a particular technology of water utilization. Therefore, a classification of water quality can be constructed on the basis of USSR State Standards that define water quality in relation to specific modes of water use. Such standards should include technical specifications on gas content and temperature of the water, acidity, dissolved, suspended and toxic substance contents, and also biological properties. From such standards of water quality a classification of lakes and streams can be developed which, in turn, can be used in a survey of waters of the USSR and as a basis for the system of water conservation. (Baker-IVI)
W84-04724

METHODOLOGICAL BASIS FOR ECOLOGICAL CLASSIFICATION OF THE QUALITY OF CONTINENTAL SURFACE WATERS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
V. N. Zhukinskiy, and O. P. Oksiyuk.
Hydrobiological Journal, Vol. 19, No. 2, p 46-53, 1983. 22 Ref.

Descriptors: *Water quality, *Surface waters, Classification, Ecology, Standards, Continental hydrology, Water management, Economic aspects.

The methodological basis for evolving an ecological classification of the quality of continental waters is discussed. This classification seems better than other available descriptions of water quality and is useful in water management and planning of water conservation measures. The quality of continental surface water is determined by its composition and properties. The quality of surface water is not always a reflection and product of the ecosystem. In some cases, as for springs, geysers, and at the fringe of glaciers, water also has a specific composition and set of properties that define its qualitative differences from other waters. Given the theory of dialectic materialism, the need exists to differentiate between the ecological and economic viewpoints on water quality. Hydrologists are faced with the problem of defining a quantitative scale for purposes of comparison of the major natural indicators of composition and properties of water. The purpose of such a scale would be conversion of these indicators to specific quantitative gradations of water quality. Many systems of hydrological analysis of water quality already exist, all based on different principles and methods of quality assessment. Ecological classifications attempt to give a combined description of surface waters on the basis of the most representative parameters of their composition and properties. (Baker-IVI)
W84-04725

HYPOLIMNETIC AERATION: CHANGES IN BACTERIAL POPULATIONS AND OXYGEN DEMAND,
York Univ., Downsview (Ontario). Dept. of Biology.
D. J. McQueen, S. S. Rao, and D. R. Lean.
Archive fur Hydrobiologie, Vol. 99, No. 4, p 498-514, 1984. 6 Fig, 5 Tab, 65 Ref.

Descriptors: *Aeration, *Dissolved oxygen, *Bacteria, *Lake St. George, *Ontario, Hypolimnion, Heterotrophic bacteria, Winterkill, Oxygen demand, Seasonal variation.

The effects of hypolimnetic aeration on bacterial populations and oxygen depletion rates were investigated at Lake St. George, Ontario, using two experimental enclosures (aerated and control) 8 m in diameter by 14 m deep and open to the mudwater interface. The experiment began on June 17, 1980 and ended on October 27, 1981. Total bacteria and respiring bacteria were measured using the INT-formazan reduction technique and aerobic heterotrophic bacteria were measured by the plate count procedure. Throughout the experiment there were no significant differences in any of these counts when the aerated and control enclosures were compared. Also, in the deep (8, 12 and 14 m) samples, total and % respiring bacteria were not related to oxygen concentrations, but both changed with season. Despite these results, hypolimnetic oxygen demand was much greater (0.5 to 0.9 mg/l/d) in the aerated enclosure than in the control which contained almost no oxygen. These results suggest that aerator designs must include substantial allowances for induced oxygen demand. They also suggest that the INT-formazan reduction technique might be unable to detect the increased bacterial activity caused by the addition of oxygen to hypolimnetic water. Finally, the enclosures did not receive any air during the winter and the enclosure that had received summer aeration suffered from winter kill, whereas the control showed a normal oxygen profile. This suggests that summer aeration creates an abnormally high winter oxygen demand so that winter aeration may also be necessary. (Author's abstract)
W84-04756

HYPOLIMNETIC AERATION AND ZOOPLANKTON DISTRIBUTION: A POSSIBLE LIMITATION TO THE RESTORATION OF COLD-WATER FISH PRODUCTION,
York Univ. (England). Dept. of Biology.
C. T. Taggart.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 191-198, January, 1984. 6 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake restoration, *Aeration, *Zooplankton, Crustaceans, Rotifers, Hypolimnion, Predation, Kettle lakes, Fish food, Anoxic conditions, Toxicity, Metalimnion.

Hypolimnetic aeration of a 1.23-ha eutrophic kettle lake during two consecutive summers increased (O2) to more than 4 mg/L in the hypolimnion for extended periods. This improvement did not lead to the expected development of crustacean populations in the previously anoxic, zooplankton-deficient hypolimnion. The rotifer Filinia longiseta was the only zooplankter present, as isolated populations, in both the epilimnion and hypolimnion

during summer. Eighty percent of the summer zooplankton community occurred exclusively in the epilimnion, and this was related to the development of an anoxic and toxic metalimnion that restricted migration from the epilimnion to the hypolimnion. Confinement of the zooplankton to the epilimnion coupled with predation by fathead minnows (Pimephales promelas) appeared to be responsible for the change in the zooplankton community from large cladocerans and copepods to smaller species. Hypolimnetic aeration as a means of restoring or enhancing the production of cold-water fish may be thwarted by the development of a stable anoxic and toxic metalimnion that precludes the development of the zooplankton food resource. (Author's abstract)
W84-04765

RESULTS AND GOALS OF RATIONAL WATER USE AND WATER CONSERVATION IN SOCIALIST AGRICULTURE (ERGEBNISSE UND AUFGABEN BEI DER RATIONELLEN WASSERVERWENDUNG UND DEM SCHUTZ DER GEWASSER IN DER SOZIALISTISCHEN LANDWIRTSCHAFT),
For primary bibliographic entry see Field 3F.
W84-04785

THE CONTRIBUTION OF SOCIALIST AGRICULTURE TO THE IMPLEMENTATION OF THE SPECIFICATIONS OF THE NEW WATER LAW (DER BEITRAG DER SOZIALISTISCHEN LANDWIRTSCHAFT ZUR DURCHSETZUNG DER BESTIMMUNGEN DES NEUEN WASSERGESETZES),
For primary bibliographic entry see Field 3F.
W84-04786

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MEDIATION IN THE ESTUARY,
Conservation Foundation, Washington, DC.
S. Gusman, and V. Huser.
Coastal Zone Management Journal, Vol. 11, No. 4, p 273-295, 1984. 26 Ref.

Descriptors: *Estuaries, *Mediation, Port facilities, Management planning, Regional development, Resources development, Water resources development, Policy making, Columbia River esturary, Decision making, Administration.

Certain key disputes remained unresolved after extensive efforts by the Columbia River Estuary Study Taskforce (CREST) to develop a management plan for the estuary and its shorelands. The remaining disputes, involving conflicts between resource protection and port development, were resolved by the mediation process. This process, involving exploration, process design, negotiation, and implementation phases, led to the signing of an agreement by twelve negotiators, the subsequent endorsement of the agreement by the federal, state, and local governmental bodies they represented, and the incorporation of the terms of the agreement into the comprehensive plans of local governments. The agreement describes the particular kinds of port-related development that might be appropriate at specific sites in the estuary and the conditions under which such development might take place. It also outlines areas where development alteration would not occur. For some of the sites it presents constraints on dredge-and-fill activities, turning basin and navigation-channel depths and widths, corridors for pile supported causeways and accessways, and mitigation policies. (Murphy-IVI)
W84-04196

DEVELOPMENT AND APPLICATION OF MODELS FOR PLANNING OPTIMAL WATER REUSE,
Texas Univ. at Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 3C.
W84-04240

THE APPLICATION OF A MANAGEMENT MODEL TO A RURAL WATER SUPPLY PROJECT IN MALAWI,
Birmingham Univ. (England). Inst. of Local Government.
C. F. Palmer.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 6, p 523-528, December, 1983. 5 Fig, 7 Ref.

Descriptors: *Planning, *Water supply development, *Malawi, *Wells, Water supply, Water resources development, Drinking water, Developing countries.

This project was designed to supply safe drinking water to 60,000 people per year in Malawi, through the construction of 600 hand-dug wells, each serving a population of about 100. The overall responsibility for managing the project came under the wells engineer. A vital requirement for the success of the project was for the voluntary community to be properly organized in order to have the well digging completed before the arrival of a skilled crew to carry out the well-lining and the installation of the pumps. The project objectives were not achieved by the end of 1980 and a further assessment of the organizational model and the logical framework and matrix with the monitoring system was carried out. The main reasons for the failure could be attributed to poor management and particularly to the control aspect, despite the assistance of the logical framework and system adopted for monitoring. Network planning was then applied. The network technique was a great success, particularly when used in conjunction with complementary management aids such as the Gnatt chart and resource bar and histogram. (Baker-IVI)
W84-04315

GUIDELINES FOR IMPROVED INSTITUTIONAL ANALYSIS IN WATER RESOURCES PLANNING,
Arizona Univ., Tucson. Dept. of Political Science.
H. M. Ingram, D. E. Mann, G. D. Weatherford, and H. J. Cortner.
Water Resources Research, Vol. 20, No. 3, p 323-334, March, 1984. 47 Ref.

Descriptors: *Institutional constraints, *Planning, Water resource development, Decision making.

Institutional factors are often among the most formidable obstacles to the development and implementation of feasible water resource programs. Guidelines for gathering and analyzing information on institutional factors as part of water resource planning and evaluation activities are presented. In approaching the analysis of current institutional arrangements, analysts should pay particular attention to (1) the actors and their stakes in the decision-making process; (2) the political and decision-making resources actors have available to pursue their interests; and (3) the biases of the alternative decision-making structures, through which various water resource decisions are made. While institutional analysis can pinpoint important barriers and constraints to plan implementation, it is of most use when it goes beyond a description and analysis of current institutional arrangements to assess possible strategies and solutions that can be applied to the problems identified. (Author's abstract)
W84-04357

STOCHASTIC STREAMFLOW MODELS FOR HYDROELECTRIC SYSTEMS,
Centro de Pesquisas de Energia Electrica, Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 2E.
W84-04362

MODELING OF WATER QUANTITY AND QUALITY FOR RIVER BASIN PLANNING,
New Hampshire Univ., Durham. Water Resources Research Center.
S. L. Dingman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84163179, Price codes: A05 in paper copy, A01 in microfiche. Research Report 39, April, 1983. 78 p, 19 Fig, 2 Tab, 25 Ref, 3 Append. Project No. OWRT A-059-NH (2), Contract/Grant No. 14-34-0001-2131.

Descriptors: *River basins planning, Water quality, *Dissolved oxygen, *Phosphorus, *New Hampshire, Merrimack River, *Model studies, Water pollution sources, Nonpoint pollution sources, Water pollution effects.

The objective of this study was to develop and test a river-basin planning model incorporating the effects of point and non-point sources of pollution on water quality. The model simulates the quantity and quality relations in a river network under critical low-flow conditions, and incorporates precise and hydrologically sound definitions of demand and supply. Flow and water quality are modeled at use sites (municipalities or industrial locations) by simple equations that allow planners to evaluate the effects of a complete set of structural and non-structural alternatives for meetng future water demands. The model was used to compute critical dissolved-oxygen concentrations for the Merrimack River Basin in New Hampshire, and showed encouraging correpondence with measured values. Phosphorus is also an important water-quality constituent, and extensive field studies of the behavior of that element were carried out in southeastern New Hampshire to elucidate its behavior in stream networks. It was found that given stream reach acts as a source of phosphorus under some conditions and a sink under others. It appeared that a chemical-kinetic effect and the erosion and deposition of fine sediments largely controlled this behavior. The study has established the need for water-resource planning models, described the specific elements of such models, demonstrated the feasibility of developing and applying such models in New England, and identified specific areas where research will contribute to the improvement of planning models.
W84-04411

WATER CONSERVATION: THE STRUGGLE OVER DEFINITION,
Southern Illinois Univ. at Carbondale. Dept. of Geography.
For primary bibliographic entry see Field 3D.
W84-04566

INFORMATION RETRIEVAL FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT,
Quebec Univ., Sainte-Foy.
D. Couillard.
Journal of Environmental Systems, Vol. 13, No. 3, p 205-230, 1983-84. 9 Tab, 86 Ref. National Research Council of Canada grant A3711.

Descriptors: *Information retrieval, *Environmental impact statement, Water quality management, Resources management, Water management, Optimum development plans, Land use, Quebec, Canada.

A study of the possible advantages of land use analysis (land indicators) appears to be a necessary preliminary step to the selection of data for acquisition. Researchers who report data on the physical, chemical and biological quality of water always do so with reference to the land in the basin under study. Two pertinent questions which arise are therefore: just how far should this analysis go; and how should results be optimally used to solve problems relating to water quality. This article should therefore be considered as a preliminary study towards the development of an integrated method for water quality data acquisition. The choice of data is approached from the perspective of land use and the way in which the data are to be used. This paper is intended to give a general idea of the physical and human characteristics of watersheds. This appreciation of a basin constitutes the first step in the determination of the problems of environmental impacts. For the Province of Quebec (Canada) as a case study, this publication

provides a list of the main reference documents and sources of data on the physical and human characteristics of basins. At first sight, there is virtually no need to collect additional data for the purpose of preliminary interpretation of water quality data. (Author's abstract)
W84-04604

THE METROPOLITAN WATER ROUNDTABLE: RESOURCE ALLOCATION THROUGH CONFLICT MANAGEMENT,
ACCORD, Los Altos, CA.
W. J. D. Kennedy, and H. Lansford.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 67-78, March, 1983. 1 Fig.

Descriptors: *Water management, *Planning, *Decision making, *Denver, *Colorado, Water supply, Roundtable, Management techniques.

Two facts underlie every decision about the allocation and use of water in Colorado: it is naturally scarce and it is legally transferable. Because of these factors it responds to market forces. Proposals for meeting the future water needs of metropolitan Denver have been the subject of intense dispute and costly litigation for decades. Although Denver has been diverting water from the western slope of the Rocky Mountains since the 1930s, its attempts to pursue further diversions are fraught with controversy. A new approach to water management planning was adopted, called the Roundtable. A set of rules which were to be used in meetings attended by committee members is described. The most dramatic accomplishment of the Roundtable was the draft water development agreement, which was unprecedented in the history of the state. However, other accomplishments were also made, including the development of a deeper understanding among the various interest groups and respect for each others opinions. Before the Roundtable experience most of these groups would not talk with each other, let alone work together. The Metropolitan Water Development Agreement is an agreement between the Denver Water Department and almost fifty suburban water providers to share the costs and yields of future metropolitan water development. All the people who initiated this novel approach to development and funding were either Roundtable members or invited observers. (Baker-IVI)
W84-04613

THE 29TH CONFERENCE OF THE HEADS OF WATER MANAGEMENT AGENCIES OF COMECON MEMBER COUNTRIES IN CUBA (29. TAGUNG DER LEITER DER WASSERWIRTSCHAFTSORGANE DER MITGLIEDSLANDER DES RGW IN KUBA),
H.-J. Machold.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 91-92, March, 1983.

Descriptors: *Water management, *Planning, *Conference, Water pollution control, Wastewater treatment, Water reuse, Water use, Automation.

The 29th Conference of the Heads of Water Management Agencies (WMA) of COMECON member countries took place from 13 to 18 September 1982 in Havana, Cuba. The Cuban conference president reported on the political and economic results of cooperation with COMECON countries over the past 20 yr on in the water management field: it was determined that work on more than 70 complex scientific and technological problems had been effective in long-term water management planning within the framework of total economic planning, in analysis and rational use of water resources, and in water pollution prevention. The work also yielded a prognosis on water management development within COMECON until 1990. Results of studies carried out since 1966 concerning the creation of 1,714 standards for water and wastewater in specific industries and agriculture were announced together with the development of process analysis in industry for the purpose of the introduction of closed water circuits. Principles for assessing the effects of the chemicalization of agriculture on water quality and for the forecasting of water quality at wastewater inlet points had been worked out. Since 1976, the terminology of 15 standard and > 1,500 scientific terms has been defined. Much time was spent on future directions in technological research and continued progress in COMECON's complex water plan, particularly with regard to rational water use and automation. Research on microprocessors and the creation of COMECON standards for apparatus and equipment will occur. (Gish-IVI)
W84-04780

THE ACHIEVEMENTS OF CUBAN WATER MANAGEMENT - 20 YEARS OF WASTE MANAGEMENT IN THE REPUBLIC OF CUBA (DIE ERRUNGENSCHAFTEN DER KUBANISCHEN WASSERWIRTSCHAFT - 20 JAHRE WASSERWIRTSCHAFT IN DER REPUBLIK KUBA),
For primary bibliographic entry see Field 4A.
W84-04781

6B. Evaluation Process

FACING THE LAKE: THE COASTWATCHERS OF RACINE COUNTY, WISCONSIN,
Wisconsin Univ.-Madison. Sea Grant Inst.
J. P. Keillor, and B. Gruning.
Coastal Zone Management Journal, Vol. 11, No. 4, p 297-315, 1984. 2 Fig, 27 Ref.

Descriptors: *Erosion control, *Racine County, *Wisconsin, *Lake Michigan, *Lake shores, Great Lakes, Waves, Shore protection, Beaches, Coastal zone management, Surface runoff, Storm seepage.

Shoreline erosion and coastal development are management issues in the Great Lakes region that have been examined over the past four years by local governments in Racine County (Wisconsin) with trained volunteers gathering information so that a timely management of coastal development can occur. The objectives of the Racine Coastwatch Program are to understand the effects and importance of wave action on shoreline erosion, on beaches, and on shore protection structures; to provide data which will supplement and extend the geographical significance of data gathered by researchers at coastal monitoring sites in neighboring countries; to observe events such as fish die-offs, algal blooms, and oil spills; and to learn how well a volunteer program can function, and how much coastline an observer can watch. The coastwatchers gave Racine County a line of observers to provide an early warning of problems and some understanding of how the lake influences the coast. The county and towns learned that two processes amenable to control, surface runoff and subsurface seepage, are important factors in local bluff slumping. The coastwatch information was transferred into management practices in a number of instances. (Baker-IVI)
W84-04197

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
R. A. Fontaine, M. E. Moss, J. A. Smath, and W. O. Thomas, Jr.
USGS Open-File Report 83-261, 1983. 81 p, 17 Fig, 17 Tab, 23 Ref.

Descriptors: *Hydrologic data, *Stream-gaging, Stream discharge, Data use, *Maine, Program analysis, Risks, *Cost-effectiveness.

Data uses and funding sources were identified for the 51 continuous stream gages currently being operated in Maine. Three stream-gages were identified as having insufficient reason to continue their operation. Operation of these stations were identified as having uses specific only to short-term studies; it is recommended that these stations be discontinued at the end of the data-collection phases of the studies. The remaining 45 stations should be maintained in the program for the foreseeable future. The current policy for operation of the 45-station program would require $180,300 per year. The average standard error of estimation of streamflow record is 18.5 percent. It was shown that this overall level of accuracy at the 45 sites could be maintained with a budget of $170,000 if the gaging resources were redistributed among the gages. A minimum budget of $155,000 is required to operate the 45-gage program; a budget less than this does not permit proper service and maintenance of the gages and recorders. At the minimum budget, the average standard error is 26.0 percent. The maximum budget analyzed was $350,000, which resulted in an average standard error of 9.2 percent. Large parts of Maine's interior were identified as having sparse stream-flow data. It was recommended that this sparsity should be remedied as funds can be made available. (USGS)
W84-04246

WATER QUALITY MANAGEMENT DECISIONS ON TWO OKLAHOMA STREAMS,
Corps of Engineers, Tulsa, OK.
For primary bibliographic entry see Field 5G.
W84-04327

APPLIED SIMILARITY CRITERIA IN THE SCALE-UP FROM EXISTING TO LARGE MSF DESALINATION PLANTS,
Aquila Univ. (Italy). Facolta di Ingegneria.
For primary bibliographic entry see Field 3A.
W84-04553

DEVELOPING JOINT WATER PROJECTS,
Black and Veatch, Kansas City, MO.
R. D. Hardten.
American Water Works Association Journal, Vol. 76, No. 4, p 131-133, April, 1984. 2 Fig, 1 Tab.

Descriptors: *Planning, *Water distribution, *Water treatment, *Utilities, Decision making, Water supply development, Economic aspects, Economies of scale, Municipal water, Rural areas, Cost sharing.

Because of the magnitude of current and projected costs associated with constructing major water utility facilities, more innovative methods are required to raise needed capital. One method for water utilities is to use joint development and cost sharing, which result in effective planning, sharing risks, sharing resources, eliminating duplication of effort, and economies-of-scale. The cost of financing improvements can be shared by each party, based on expected future requirements. Central cities with declining populations would not be burdened with subsidizing suburban growth. The suburbs would benefit by the increased probability that a reliable system, adequate to meet their needs, will be built and maintained. The advantages of joint project development and cost sharing can benefit both central cities and suburbs. (Baker-IVI)
W84-04581

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ELASTICITY OF DEMAND FOR RESIDENTIAL WATER: POLICY IMPLICATIONS FOR SOUTHERN ARIZONA,
Arizona Univ., Tucson. Coll. of Business and Public Administration.
For primary bibliographic entry see Field 3D.
W84-04388

6D. Water Demand

SOURCE, USE, AND DISPOSITION OF WATER IN FLORIDA, 1980,
Geological Survey, Tallahassee, FL. Water Resources Div.
S. D. Leach.
Available from the Ofss, USGS, Lakewood CO 80225, Price: $44.50 paper copy, $3.50 microfiche. USGS Water-Resources Investigations Report 82-4090, 1983. 337 p, 27 Fig, 45 Tab, 35 Ref.

Group 6D—Water Demand

Descriptors: *Florida, *Water use, *Water utilization, Waterworks, *Watersheds, Agriculture, Areal hydrogeology, Consumptive use, Freshwater, *Groundwater, Hydrology, Industrial water, *Irrigation, Irrigation water, Acreage, Basins, Saline water, Supply, *Surface water.

An average of 21,206 million gallons of water was withdrawn for use in Florida each day for the combined use for public supplies, rural domestic and livestock, industrial self-supplied, irrigation, and thermoelectric power generation. This amount, broken down into 7,309 millions gallons per day of freshwater and 13,897 million gallons per day of saline water, indicates an increase of more than 40 percent for all uses during the 10-year period 1970-80. The largest user of freshwater in Florida was for irrigation--2,997 million gallons per day which also is responsible for the greatest consumption, 1,530 million gallons on the average each day or about half the water applied. The remaining use of freshwater amounted to 1,859 million gallons per day for thermoelectric power generation (which also used about 13.7 billion gallons per day of saline water); 1,361 million gallons per day of public supply; 797 million gallons per day for industrial use other than thermoelectric power generation; and 310 million gallons per day, on the average, for rural domestic and livestock use. (USGS)
W84-04261

GROUND-WATER-USE TRENDS IN THE TWIN CITIES METROPOLITAN AREA, MINNESOTA, 1880-1980,
Geological Survey, St. Paul, MN. Water Resources Div.
M. A. Horn.
USGS Water-Resources Investigations Report 83-4033, 1983. 37 p, 16 Fig, 8 Tab, 36 Ref.

Descriptors: *Water ulitization, *Groundwater, Municipal water, Industrial water, Air conditioning, Irrigation water, *Minnesota, Minneapolis-St. Paul metropolitan area, Twin Cities, Prairie due Chien-Jordan aquifer.

Detailed ground-water-use information from 1880 to 1980 has been collected and analyzed for the Twin Cities metropolitan area. Interpretation of historic water-use data was required to help water-resource planners and managers assess future trends in water use. Methods were developed to collect, evaluate, store, and retrieve information from all local, State, and Federal agencies' records and publications. A computerized water-use data base was constructed to facilitate generation of statistics on water-use trends and to store and retrieve data. Ground-water use was analyzed by use category and aquifer and several trends were observed. Eighty percent of ground water currently withdrawn is from wells in the Prairie due Chien-Jordan aquifer. Ground-water use increased from 1880 until the early 1970's and then declined slightly in the late 1970's. Industrial use in particular declined during the 1970's as a result of conservation that was prompted by increased sewage-treatment and energy costs. The intensity of pumping had decreased within the St. Paul and Minneapolis city limits and increased outside the city limits. The seasonal variability of ground-water use became more pronounced as the percentage of water used for irrigation and air conditioning increased. (USGS)
W84-04266

BASINWIDE WATER REQUIREMENT ESTIMATION IN SOUTHERN FLORIDA,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W84-04438

WATER DEMAND STANDARDS IN DAIRY FARMING (WASSERBEDARFSNORMEN IN DER RINDERPRODUKTION),
Akademie der Wissenschaften der DDR, Iden-Rohrbeck. Inst. fuer Rinderproduktion.
E. Kaiser.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 117-119, April, 1983. 5 Fig, 4 Tab, 10 Ref.

Descriptors: *Water demand, *Dairy industry, *Farms, *East Germany, Water conservation, Water management, Cattle, Cleaning.

Water demand in dairy farming in the German Democratic Republic has risen from 50-60 l/cow/day at the beginning of the 1960s to as much as 150 l/cow/day, due partly to higher standards of hygiene but also to varying management practices among farmers. If, in a milking herd of 1,930 cows, 20 l less water/cow/day were used, yearly savings would be 14,000 cu m water, 14,000 cu m liquid manure, and 16,800 kg diesel fuel and 71,000 Marks for preparation and transport of liquid manure. In order to develop standards for water demand for the industry, water volume measurements and water-management process analyses were performed for every stage of production in on 50 farms. The data collected varied widely, so that it was impossible to use mean values or progressive mean values directly as the norm for total water demand. Data for individual production stages showed that variability was due to idiosyncratic cleaning procedures and careless water use. A synthesis of the process analysis data for each production stage was therefore made to establish water use norms for a healthy herd so that satisfactory hygiene, work, and production conditions would prevail while water would be used economically. Using these norms for individual production stages, a norm for total water use for the sample herd of 1,930 cows was calculated. The practicability of the norms was tested over a four-month period in a herd of 1,930 in which water demand had been very high. (Gish-IVI)
W84-04787

PROBLEMS OF WATER DEMAND ACCORDING TO VOLUME AND QUALITY FOR THE PRODUCTION OF YOUNG FISH (PROBLEME DES WASSERBEDARFS NACH MENGE UND GUTE FUR DIE SATZFISCHPRODUKTION),
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
G. Bartsch.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 4, p 130-133, April, 1983.

Descriptors: *Water demand, *Fish farming, Aquaculture, Water quality, Wastewater treatment, Water supply, Dissolved oxygen, Aeration.

The Rodertal Fish Farm (RFF) has 28 pools covering 230 hectares (ha) with a total volume of 2.76 million cu m. It specializes in young fry, mostly carp, as a supplier to other farms. An increase in fish production to 140% of the present level (300 tonnes) is planned. Water is becoming the limiting factor in intensive fish farming. No evaporation or seepage measurements have been made at RFF, but experience has shown that a water inflow of 1.0 l/sec/ha is required; 0.8 l/sec/ha if the pool is surrounded by trees. Considering this 0.2 l difference, with pools filled for 320 days at RFF, there is 1.27 million cu m inflow water for which the need is not known. The maximal estimated inflow level of 5 l/sec/ha for winter pools and those in which food pellets (FP) are used cannot be met by available water supplies, though possibilities for using remote supplies are being investigated. Good water quality allows a reduction in the required level to 3 l/sec/ha; to achieve this, a fully biological wastewater treatment plant is planned for the supply river. Significant problems at RFF FP pools are created by O2 inflow levels of 1.8-2.2 mg/l where levels of 5-6 mg are needed; the feasibility of artificial enrichment is to be studied. Water demand can be reduced by constructing pools connected by cascades; however diseases are thereby more easily transmitted, and it is more difficult to combat pollution in inflow water. A compromise between water and fishing concerns must be reached. (Gish-IVI)
W84-04790

6E. Water Law and Institutions

REGULATION OF LAND USE PRACTICES FOR AREAS SURROUNDING AQUIFERS - ECONOMIC AND LEGAL IMPLICATIONS,
Connecticut Univ., Storrs. Dept. of Business Environment and Policy.
M. Huffmire, L. Frankel, and F. C. Reitman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159763, Price codes: A16 in paper copy, A01 in microfiche.
Connecticut Institute of Water Resources, Storrs, Completion Report (1982). 342 p, 6 Fig. Project No. OWRT B-015-CONN (3), Contract/Grant No. 14-34-0001-0213.

Descriptors: Aquifers, Groundwater, Aquifer protection, Cost-benefit analysis, Aquifer recharge, Water policy, *Land use, *Legal aspects, *Economic impact, Long term planning, Institutional constraints, *Connecticut, *Groundwater management, *Aquifer management, *Regional planning, Groundwater pollution control.

Regional increases in the demand for water have led to a growing desire to tap underground water sources. Evidence indicates that many of Connecticut's commercially feasible aquifers are already badly degraded, and that without immediate action to restrict harmful surface practices, they will be followed by others. Economic evidence indicates that the state as a whole can reap substantial benefits by an intelligently conceived and implemented program of land use monitoring and water resource planning, but that such a program can only be undertaken through additional legislation and funding. Current legal mechanisms for the orderly management of water resources are insufficient and need overhaul. Greater stress must be placed on comprehensive long-term planning on the regional level, and strong institutional arrangements to implement this planning process are necessary.
W84-04234

GUIDELINES FOR IMPROVED INSTITUTIONAL ANALYSIS IN WATER RESOURCES PLANNING,
Arizona Univ., Tucson. Dept. of Political Science.
For primary bibliographic entry see Field 6A.
W84-04357

DEVELOPMENT OF A NATIONAL GROUNDWATER PROTECTION POLICY,
J. S. Dycus.
Boston College Environmental Affairs Law Review, Vol. 11, No. 2, p 211-271, 1984. 390 Ref.

Descriptors: *Groundwater management, *Regulations, *Water quality control, Legislation, Policy making, Environmental Protection Agency, Hazardous materials, Waste disposal.

The Environmental Protection Agency has developed a draft proposed Groundwater Policy which in many ways resembles the old one, most importantly in its reliance on the development of effective state rules and state enforcement. The new proposal also relies upon the adequacy of existing federal statutes and programs. It leaves entirely for state control any questions for groundwater supply, and it envisions the adoption of a classification or zoning scheme for groundwater. The draft is considered here as a convenient vehicle for discussion of issues on the development of a wise groundwater policy. The flaws in the proposal are examined and the body of statutory authority which is available to the EPA for the protection of groundwater but which the agency seems remiss to employ is reviewed. The proper roles of federal and state governments are considered along with an alternate strategy more likely to meet the stated goal. It is argued that only an unwavering committment to the protection of the nation's groundwater supplies, reflected in a consistent and comprehensive federal policy, will forestall the serious threat currently facing our supply of drinking and irrigation water. (Baker-IVI)
W84-04533

THE DILEMMA OF THE DOWNSTREAM STATE: THE UNTIMELY DEMISE OF FEDERAL COMMON LAW NUISANCE,
M. Collins.

Boston College Environmental Affairs Law Review, Vol. 11, No. 2, p 295-412, 1984. 522 Ref.

Descriptors: *Common law, *Nuisance, *Lake Michigan, *Wisconsin, *Milwaukee, *Illinois, Supreme Court, Clean Water Act, State jurisdiction, Federal jurisdiction, Water pollution control, Wastewater disposal.

A controversy arose between the City of Milwaukee and Illinois when the state attempted to protect its interests in Lake Michigan as a source of drinking water and great recreational and aesthetic value. Illinois' complaint focused on two categories of discharges from Milwaukee: municipal sewage treatment plant discharges and sewer overflows. The application of the Clean Water Act to the problem is detailed. The Supreme Court decision which was reached eventually set forth a broad foundation for the displacement of federal common law nuisance by environmental statutes in general. In light of the broad language of the Supreme Court's opinions and the Court's underlying approach to legislative intent in the case it appears that virtually any legislative scheme which regulates a given area requires the preemption of federal common law. The Court's legislative inquiry does not directly support the conclusion that Congress intended that pollution control standards under the NPDES program be the exclusive means to abate pollution hazards. A closer look at the decision reveals that the factors supporting the Court's decision all relate to the legislative delegation of authority to a specialized expert agency, the EPA, charged with policing dischargers and thoroughly regulating discharges through a permit program. Primary efforts to control and prevent enviromental pollution have been and must continue to be statutory. (Baker-IVI)
W84-04534

LEGAL ASPECTS OF DAM SAFETY,
Western New England Coll., Springfield, MA. School of Law.
D. Binder.
International Water Power and Dam Construction, Vol. 36, No. 4, p 24-26, April, 1984. 14 Ref.

Descriptors: *Dam failure, *Legal aspects, Liability, Public rights, Dam construction, Safety, Negligence, Flood damage, Flash floods.

The approach to dam liability in the United States varies from state to state throughout the country. In addition, the approach to dam failure may not always be consistent with the response to failures of other civil structures. The three most common theories of relief for the victims of a dam failure are negligence, strict liability, and, to a lesser degree, violation of statutes. Occasionally a state will have a statute which imposes strict liability in dam failures. Liability has also occasionally been imposed on a theory of trespass, whereby the defendant has caused water to overflow on another's land. In general, a plaintiff cannot recover if the damage would have occurred in spite of the dam's existence. Such a result can occur when a storm is of such intensity that the plaintiff would have been washed away regardless of a dam's safety. There is no legal liability because there is no causation in fact. With respect to flash floods, the rule which has evolved is that the flood must be so extraordinary that the reasonably prudent person could not have anticipated it. To use the Act of God defence certain requirements must usually be met: unforeseeability by reasonable human intelligence and the absence of a human agency causing the alleged damage. Thus, if a similar storm had occurred before, or could be anticipated using modern techniques, or if the storm or damage were otherwise reasonably foreseeable, even if not probably, the Act of God will not serve as a defence. (Baker-IVI)
W84-04665

6G. Ecologic Impact Of Water Development

POPULATION BIOLOGY IN THE COURTROOM: THE HUDSON RIVER CONTROVERSY,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5C.
W83-04283

VALUE OF PRAIRIE WETLANDS TO DUCK BROODS,
Fish and Wildlife Service, Jamestown, ND. Northern Prairie Wildlife Research Center.
H. F. Duebbert, and A. M. Frank.
Wildlife Society Bulletin, Vol. 12, No. 1, p 27-34, Spring, 1984. 2 Fig, 5 Tab, 16 Ref.

Descriptors: *Wetlands, *Ducks, *Wildlife management, *Prairies, *North Dakota, *South Dakota, Wildlife conservation.

A total of 4370 duck broods were observed in the prairie pothole region of North and South Dakota during 1958-1978. Dabbling duck broods made up 83% of the total, with blue-winged teal, gadwall, and mallard being the top 3 species. Fifty-eight percent of the broods were observed on semipermanent wetlands and 24% on seasonal wetlands. Brood size was reduced by about 2 ducklings between hatch and Class I. The data did not indicate a serious loss of ducklings after three broods reached water. For early-nesting species (mallard and pintail), 84 and 90% of the broods hatched by 7 July. For gadwall, blue-winged teal, and northern shoveler (later nesters), 87, 90 and 94% of broods hatched by 21 July. Preservation and management of seasonal wetlands should be given greater consideration based on these findings. (Baker-IVI)
W84-04192

HEAT TRANSFER; ENVIRONMENTAL ASPECTS,
Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W84-04199

A FISH POPULATION MODEL FOR INSTREAM FLOW ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Biology.
F. M. Williams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159680, Price codes: A03 in paper copy, A01 in microfiche. Pennsylvania Institute for Research on Land and Water Resources, University Park, Completion Report (LW8401), January, 1984. 41 p, 16 Fig, 1 Tab, 12 Ref, 2 Append. Project No. OWRT A-059-PA(1), Contract/Grant No. 14-34-0001-2140.

Descriptors: *Fish populations, *Instream flow, *Weighted usable area, Consumptive loss, Smallmouth bass, Electivity curves, Hydraulic model, Fishery habitat.

An age structured fish population model has been proposed that is responsive to flow variations that create changes in the density dependent factor, available habitat. The model was implemented for a smallmouth bass population. Simulation results, shown to be robust with respect to environmental input values and internal paramter values, indicate that flow variations have a profound effect on the magnitude and variability of early life history stages, but the adult spawning population shows extreme stability with respect to these perturbations. This may provide some insight into life history strategies in a variable environment.
W84-04238

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE STIGLER AREA, HASKELL COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2A.
W84-04267

AGRICULTURAL DEMAND FOR WATER IN LOWLAND AREAS,
For primary bibliographic entry see Field 3F.
W84-04314

BRACHYCENTRUS AMERICANUS AND B. OCCIDENTALIS (TRICHOPTERA) IN A REGULATED STREAM,
Brigham Young Univ., Provo, UT. Dept. of Zoology.
R. N. Winget.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 373-381, April, 1984. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental effects, *Dam construction, Streams, Seasonal variation, Huntington Canyon, Wasatch Plateau, Electric Lake, Macroinvertebrates.

Late instar Brachycentrus americanus larvae were collected just prior to and during normally high spring runoff. Adults were collected immediately following runoff and early instar larvae appeared during the late summer low flow period of September and October. Bicarbonate alkalinity concentrations averaged approximately 150-200 mg/l during the study with little change following impoundment of Huntington River. The pH of Huntington River waters before the dam generally ranged from 7.5 to 8.8 with lower values during winter/spring and higher values during summer/fall. Average pH was 8.1 above the lake, 7.45 at dam outfall, and 7.8 at Station D-4, located two km below Electric Lake Dam. Before the dam, temperature changes in the water in Huntington River were 18-20 degrees C, but after dam completion the temperature range was only 4-5 degrees C. Both B. americanus and B. occidentalis were stressed at Station D-4. It appears that with July to August flushes, summer hatching of B. occidentalis may be a disadvantage in Huntington River. Early spring emergence of B. occidentalis appears to have some advantage during above normal early spring runoff occurrences. Late summer hatching of B. americanus appears to be the more advantageous under the regulated flow regime of Huntington River. (Baker-IVI)
W84-04385

EFFECTS OF MULTIPHASE RESTORATION, PARTICULARLY ALUMINUM SULFATE APPLICATION, ON THE ZOOPLANKTON COMMUNITY OF A EUTROPHIC LAKE IN EASTERN WASHINGTON,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
M. V. Gibbons, F. D. Woodwick, W. H. Funk, and H. L. Gibbons.
Journal of Freshwater Ecology, Vol. 2, No. 4, p 393-404, April, 1984. 3 Fig, 16 Ref.

Descriptors: *Zooplankton, *Lake restoration, Lakes, Eutrophication, Washington, Aluminum sulfate, Sulfates, Liberty Lake.

Zooplankton populations of Liberty Lake, Washington were investigated over a span of four years to determine the short-term effects of a series of multiphase lake restoration measures on lake zooplankton. Liberty Lake is a moderately sized, soft water lake of glacial origin. The lake is a weakly buffered system with the entire volume of 20100000 cubic meters essentially euphotic throughout the year. Thirty-nine species of zooplankton were identified during the study period. In response to restoration treatments, the zooplankton community exhibited some short term population fluctuations. Suction dredging had no apparent effect upon the zooplankton in the lake. The gross effects of aluminum sulfate applications were also minimal. A sharp decline in numbers was noted in all major groups immediately following each alum application, but recovery was evident in the maintenance of typical seasonal growth patterns. The Eucopepoda exhibited rapid recovery following both alum treatments, responding most

favorably to the short term oligotrophic-like conditions apparently created by the treatments. Similarities in zooplankton response to the alum application and to the May 1980 Mt. St. Helens ashfall are briefly discussed. (Baker-IVI)
W84-04386

THE FLOODING OF JAMES BAY,
S. McCutcheon.
New Scientist, Vol. 1011, No. 1402, p 35-41, 22 March, 1984. 5 Fig.

Descriptors: *Water resources development, *Environmental effects, *James Bay, *Quebec, Hydroelectric plants, Earthquakes, Flooding, Cree Indians, Indian rights.

During the past 10 years, James Bay in Canada has become the scene of a massive hydroelectric powerplant development. While the plan was devised to make use of the wilderness areas, little consideration was originally given to the Cree Indians who lived in this region and depended on its natural conditions for their needs. Opponents to the scheme forecasted vast disturbances of nature suggesting earthquakes and climatic changes. In order to keep track of the changes brought about to the environment by the project, extensive record keeping was started of the flora and fauna in the area. Many of the activities of the construction crews were supervised so that damage to the environment during the construction phase would be kept to a minimum. The Cree Indians united and became politically active for the first time, using the judicial system to attempt to stop work. Finally they did achieve native land reserves and exclusive hunting, fishing and trapping rights incomes for hunters and trappers who spend more than half the year in the bush; a voice in approving or rejecting, on the basis of environmental impact, developments in the region; a voice in the use of funds set aside to correct damage already done to the environment; and a compensation of $225 million. Today it is clear that the devastations foretold did not happen. The region is coping extremely well with the changes man has brought to it. The attention paid to taking care of the environment certainly had a great part to play in the successful completion of the task. (Baker-IVI)
W84-04397

ECONOMICS OF PRAIRIE WETLAND DRAINAGE,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1465-1475, September-October, 1983. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Wetlands, *Drainage, *Minnesota, *Economic feasibility, Prairies, Surface drainage, Tile drainage, Economic aspects, Farms, Nuisance.

Surface ditch and subsurface tile drainage of scattered prairie wetlands in west central Minnesota and general field drainage in south central Minnesota are representative of contemporary prairie wetland drainage. Data from a 1981 survey of farm operators regarding on-farm drainage are used to: estimate the costs of constructing wetland drains, estimate the returns from wetland drainage, and most importantly, examine the economic feasibility of on-farm wetland drainage. All of the drained wetlands are generally profitable. Where they were not profitable, they may have been feasible in terms of overall efficient field operations. Social values of wetland benefits may be larger than individual agricultural returns on drained wetlands, but until social values can be reliably estimated, there is no yardstick to determine what to pay to preserve wetlands. Outright prohibition of drainage is not politically feasible in rural areas. Most existing preservation programs base payments on net returns to drainage or cash rent for similar cropland. This ignores the nuisance factor and may be a prime reason for lack of participation. (Moore-IVI)
W84-04474

INTRODUCTION TO THE DELTA CASE STUDIES,
Rijkswaterstaat-Deltadienst, Rijswijk (Netherlands).
M. Knoester.
Water Science and Technology, Vol. 16, No. 1/2, p 1-9, 1984. 6 Fig, 7 Ref.

Descriptors: *Environmental effects, *Flood control, *Netherlands, *Dutch Delta Region, Estuarine environment, Basins, Shellfish, Barriers.

In 1953 a disastrous storm flood hit the Dutch Delta Region. Since that time an extensive program for safe guarding this area has been carried out. An essential part of that plan is the establishment of a new primary defence against storm floods in the form of water barriers built between the islands. The basins in between, formerly estuarine systems, are each affected in a different way. The coincidence of the interests of both the fishing industry and nature conservation eventually led in 1976 to a radical modification of the Delta Project, aimed at ensuring both the safety of the region and the retention of the tidal environment in the Eastern Scheldt. Three case studies, each concerned with a particular stretch of the estuary, have been conducted. The Hollandsch Diep and the Haringvliet formed the main outflow channel of the Rhine and the Meuse. These were transformed in 1970 from a tidal river estuary into a freshwater lake with irregular changes in water level. The hydraulic-engineering work carried out in this area has been executed in accordance with the original Delta Plan. Lake Grevelingen originally was an arm of the sea. After closure, the Grevelingen was in the process of becoming a stretch of brackish water and it is now managed as a stagnant saltwater lake. There is no other similar ecosystem in the region. The work here has gone according to the original plan but the process of decision-making regarding the Eastern Scheldt has left open a new possibility of choosing between fresh water and salt water. The Eastern Scheldt where the Delta works are still in the execution stage, has received the greatest impact from fishing and naturalist interests. The plan for this area is characterized by the objective of maximizing the extent of the transformation to no more than a reduction in the tidal range, and great care is being taken in the planning process for this region. (Baker-IVI)
W84-04493

THE HARINGVLIET-PROJECT: THE DEVELOPMENT OF THE RHINE-MEUSE ESTUARY FROM TIDAL INLET TO STAGNANT FRESHWATER LAKE,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
H. A. Ferguson, and W. J. Wolff.
Water Science and Technology, Vol. 16, No. 1/2, p 11-26, 1984. 7 Fig, 14 Ref.

Descriptors: *Environmental effects, *Flood control, *Haringvliet Project, *Netherlands, *Rhine-Meuse Estuary, Estuarine environment, Deltas, Barriers, Planning, Coastal engineering, Coastal waters.

In 1970 the common outlet of the Rhine and Meuse Rivers, the Haringvliet estuary, was closed by the construction of large sluices and changed thereby from a brackish tidal inlet into a stagnant freshwater lake. Ecological knowledge of the effects was available, but at that time hardly used in the design and execution of the large project. Part of the negative effects could have been avoided by timely integration of ecological knowledge in the realm of coastal engineering and by physical planning of the area. The day of the closure was an environmental turning point. Salt and brackish water were not able to enter the new lake any longer and the tidal amplitude of about 1 m changed to a semi-tide, partly dependent on the operation of the sluices, of about 20 cm. Major changes included a quick ripening of the soils in all areas which became more or less permanently dry. Plant species preferring wet soils decreased in favor of dry soil species. Phytoplankton numbers increased after closure, probably due to a combination of increased freshwater residence time, reduced current speeds and decreased turbidity. The brackish water copepod Eurytemora affinis disappeared completely, but the cladocerans Daphnia longispina and Bosmina longirostris as well as certain rotifers were able to take over. Bird fauna changes were also noted. (Baker-IVI)
W84-04494

GREVELINGEN: FROM AN ESTUARY TO A SALINE LAKE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
P. H. Nienhuis, and J. C. Huis in 't Veld.
Water Science and Technology, Vol. 16, No. 1/2, p 27-50, 1984. 22 Fig, 3 Tab, 9 Ref.

Descriptors: *Environmental effects, *Estuarine environment, *Netherlands, *Grevelingen Lake, *Grevelingen, Flood control, Deltas, Barriers, Estuary, Coastal engineering, Coastal waters, Saline waters, Ecosystems.

A number of coastal engineering and ecological considerations are given concerning the changes which have occurred as a result of turning Grevelingen estuary into saline Lake Grevelingen. New hydraulic methods were used to close the 5-7 km wide estuary at both ends. The eastern secondary dam was closed in 1964 by a combination of tight caissons and rubble-stone from a cable-way. While the loss of estuarine habitats and communities on a world scale can only partly be compensated, it is stressed that Lake Grevelingen represents a rare phenomenon among the coastal and brackish inland water bodies in Europe. The water quality is very good; nutrient loading is low. The 30 sq km eelgrass vegetation, providing food and shelter to numerous animals, is a specific community, being rare along the southern North Sea. Hard substrates of sea walls and rip-rap dams harbor a diversified community rich in biota. The benthic fauna is diversified and abundant. The fish fauna is interesting both in species number and in abundance. Large numbers of birds are found on and around the lake. The vegetation in the transition area between the saline open water and the plant growth bound to fresh water on dry land shows a valuable gradient. (Baker-IVI)
W84-04495

THE EASTERN SCHELDT PROJECT,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
M. Knoester, J. Visser, B. A. Bannink, C. J. Colijn, and W. P. A. Broeders.
Water Science and Technology, Vol. 16, No. 1/2, p 51-77, 1984. 12 Fig, 1 Tab, 14 Ref.

Descriptors: *Flood control, *Environmental effects, *Barriers, *Netherlands, Estuarine environment, Eastern Scheldt Project, Storms, Ecosystems, Water quality, Estuaries.

The Eastern Scheldt was the largest and therefore last tidal basin to be fully closed in the re-structuring of the Delta-works in Southwestern Netherlands as part of a flood protection plan. In former times the Eastern Scheldt was part of the multiple branched estuary of the rivers Rhine, Meuse and Scheldt. The largest structure in the Delta Project, the storm surge barrier, is being built at the mouth of the Eastern Scheldt. In the eastern part of the area two compartment dams with shipping locks are currently under construction. As a consequence of the construction of the compartment dams the present tidal area will be divided into two parts: the Eastern Scheldt, where tidal movements will be reduced by the barrier; and a freshwater lake system east of the dams. Currently research is being conducted to determine the various effects these changes have brought in the ecosystems of the area. Specific areas of study are concerned with the morphology of the channels and flats, the basic food chain, the organic communities, and the salt-marsh ecosystem. With the completion of the coastal engineering project in this region the environment there will continue to change and develop and will, for a variety of reasons, rightly continue to attract the attention of the scientific community. (Baker-IVI)
W84-04496

THE EFFECT OF COASTAL ENGINEERING PROJECTS ON MICROGRADIENTS AND MINERALIZATION REACTIONS IN SEDIMENTS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
H. J. Lindeboom, and A. J. J. Sandee.
Water Science and Technology, Vol. 16, No. 1/2, p 87-94, 1984. 5 Fig, 1 Tab, 12 Ref.

Descriptors: *Coastal engineering, *Environmental effects, *Mineralization, *Netherlands, *Lake Grevelingen, Coastal waters, Microelectrodes, Marine sediments, Anaerobic conditions, Aerobic conditions, Dam effects, Oxygen, Sulfides.

Mineralization reactions can take place in sediments along different aerobic and anaerobic pathways. The recent introduction of microelectrodes for ecological research has enabled the determination of oxygen and sulfide gradients in situ in the sediment. These microgradients give insight into the actual mineralization reactions taking place, and changes in these reactions can now be rapidly recorded. The use of microelectrodes in the field in Lake Grevelingen is described. The effects of dam building on oxygen and sulfide microgradients and on mineralization reactions is discussed. Although there were no data obtained before the closure was made, a comparison of the open Oosterschelde estuary with the present situation in Lake Grevelingen indicates that after closure, the microprofiles and the mineralization pattern in the lake sediment changed due to the decreased current velocities and an increased organic carbon load. The introduction of microelectrodes for ecological research has enabled a detailed study of in situ microgradients in undisturbed sediments, increasing knowledge about reactions and interaction taking place. A detailed study of the effect of coastal engineering projects on the biological reactions in the sediment is now within reach. (Baker-IVI)
W84-04497

ENVIRONMENTAL IMPACT STATEMENT ON THE PROBLEM OF A FRESH OR SALT LAKE GREVELINGEN,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
J. H. M. v.d. Meulen, J. Leentvaar, and N. M. de Rooy.
Water Science and Technology, Vol. 16, No. 1/2, p 107-120, 1984. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Environmental impact statement, *Lakes, Netherlands, Lake Grevelingen, Saline water, Systems analysis, Eutrophication, Toxicity, Carbon, Water quality control.

An Environmental Impact Statement has to be prepared concerning whether Lake Grevelingen will remain a salt-water basin or become a fresh-water basin in the near future. The system analysis approach is used to obtain the information needed for such a determination and an outline is provided of the quality of the salt-water and the fresh-water Lake Grevelingen. This approach was useful in dividing the study into coherent parts and assigning the tasks to different work groups. The only problem with this division approach was that each group tended to set criteria for an ideal water basin rather than for the basin at hand. The studies indicated that the prediction of the eutrophic level was of crucial importance for the appraisal of the lake. With respect to the prediction of the eutrophication of the fresh-water lake a number of assumptions are needed, however the results are in accordance with observations made in equivalent Dutch lakes. A possible compromise between the desire of the agricultural community on the isle Schouwen-Duiveland for fresh-water for irrigation of the fields and the desire of the groups for nature conservation, recreation and fisheries would be a salt-water Lake Grevelingen with a supply of fresh-water through a pipeline from Lake Volkerak. (Baker-IVI)
W84-04498

THE TECHNICAL AND ECONOMIC ASPECTS OF THE WATER SEPARATION SYSTEM OF THE KRAMMER LOCKS,
Rijkswaterstaat-Deltadienst, The Hague (Netherlands).
J. G. Hillen, C. P. Ockhuysen, and P. v.d. Kuur.
Water Science and Technology, Vol. 16, No. 1/2, p 131-140, 1984. 12 Fig, 1 Tab, 1 Ref.

Descriptors: *Locks, *Saltwater intrusion, Gates, Navigation, Mixing, Seawater, Saline water, Model studies, Pumping plants, Netherlands, Krammer Locks.

Technical and hydraulic aspects of the water separation system of the Krammer Locks in the Netherlands are discussed. Attention is paid to the impact on the environment, to the energy consumption of the pumping station and the consequences for inland water transport. The effect of different ways to operate these locks is shown. It is estimated that the Krammer Locks will bear a volume of 60 million tons of traffic in dead weight in 1987 and that this figure will reach 80 million tons in the year 2000. The water separation system at the locks makes use of the fact that saltwater is heavier than freshwater. When the vessel has entered the lock and both gates have been closed, the saltwater is drained from the lock chamber through a perforated floor. The freshwater is supplied by 114 wall culverts which are highly positioned along the entire length of the 2 chamber walls. The degree of mixing of salt and fresh water is discussed. (Baker-IVI)
W84-04500

RESPONSE OF MACROZOOBENTHOS TO A TEMPORAL LOWERING OF CHLORINITY: A LARGE-SCALE FIELD EXPERIMENT IN THE DUTCH DELTA AREA,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. Coosen, and R. J. Leewis.
Water Science and Technology, Vol. 16, No. 1/2, p 141-150, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Environmental effects, *Benthos, Netherlands, Deltas, Seasonal variation, Estuaries, Saline water, Volkerak sluices, Intertidal areas, Keeten-Krammer-Volkerak.

The chlorinity in the Keeten-Krammer-Volkerak area was considerably lowered during the winter of 1979/1980 due to an experimental doubling of the freshwater discharge at the Volkerak sluices. Species composition, abundance and biomass of the intertidal macrozoobenthos was studied prior to 1978, 1979 and after 1980, 1981 in order to assess the possible impact of this change in chlorinity. While species that had been abundant before the experiment were still abundant afterwards, nevertheless, species number directly after the experiment was lower than before. Some of the relatively rare species were not found immediately following the experiment but did return later. The Shannon-Weaver diversity index did not show a significant change. Sample classification using the Bray-Curtis dissimilarity index, indicated that most pre-experimental samples were similar to post-experimental samples. Dissimilarity was found between March and October samples. The water quality remained good. (Baker-IVI)
W84-04501

NAKANOUMI LAND RECLAMATION AND FRESHENING PROJECT,
Tokyo Univ. (Japan). Inst. of Applied Microbiology.
H. Ohtake.
Water Science and Technology, Vol. 16, No. 1/2, p 151-170, 1984. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental effects, *Land reclamation, Japan, Lakes, Lake Nakanoumi, Environmental impact statement, Lagoons, Coastal waters, Ecosystems, Sea of Japan.

Lake Nakanoumi is a shallow coastal lagoon connected with the Sea of Japan only by a narrow channel. The Nakanoumi Land Reclamation and Freshening Project began in 1963 with the objectives being to reclaim agricultural lands of 25 sq km from the lake and to convert the remaining water basin into a fresh water reservoir by damming its narrow entrance. Work on the project has lasted 15 years, and the natural environment of Lakes Nakanoumi and Shinji has been damaged by a variety of human activities connected with the project. Reclaimed lands are an intrusion on the natural landscape and construction works are harming the nesting ground for waders. There is a fear that the expected reservoir will be heavily damaged by the eutrophication. (Baker-IVI)
W84-04502

ECOLOGY AND THE ZUIDERZEEPROJECT,
Rijksdienst voor de Ijsselmeerpolders, Lelystad (Netherlands).
J. de Long, and J. H. Roelofs.
Water Science and Technology, Vol. 16, No. 1/2, p 171-206, 1984. 23 Fig, 2 Tab, 33 Ref.

Descriptors: *Environmental effects, *Planning, *Land reclamation, Water management, Netherlands, Zuiderzee, Estuarine environment, Zuiderzeeproject, Decision making.

Execution of the Zuiderzeeproject has brought with it large changes in this large estuarine area of over 500,000 ha. The area has been dammed and its waters changed into stagnant, eutrophic freshwaters by using the water from the river IJssel. The execution of the project over the past 60 years has indicated that it is necessary to strive as far as possible when planning and designing a new area of land toward an integrated approach including social, economic, ecological, technical, asthetic and other factors which are involved. Bringing the planners and researchers together in a very limited number of oganizations contributes highly to the quality of the work and decreases the risk of competition between many companies and simply too many different people having a part in management decisions. As much as possible, plans should be flexible to meet needs determined by ongoing studies. Finally, ecologists need to learn to integrate their scientific knowledge into the many other aspects involved in the execution of a large work. (Baker-IVI)
W84-04503

THE NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION PROJECT,
Industrial Sites and Water Resources Development Corp., Seoul (Korea).
K. K. Ho, and G. van Houweninge.
Water Science and Technology, Vol. 16, No. 1/2, p 207-222, 1984. 7 Fig, 5 Ref.

Descriptors: *Land reclamation, *Water resources development, Estuaries, Estuarine environment, Environmental effects, Nakdong Estuary, Saline water intrusion, Encroachment, Locks, Water quality.

As a result of the increasing industrial, municipal and agricultural water demand in the Nakdong River Basin, the available amount of fresh river water to repulse salinity intrusion into the lower reaches of the river rapidly decreases during the dry season. The interaction between barrage construction and the estuary and river environment was examined as attempts are made to ensure a reasonable supply of fresh water to the city of Busan. The study comprised ecological, water quality and morphological aspects. The results were incorporated into the technical design and proposed management of the barrage, so that it could meet its major objective, the avoidance of salinity intrusion into the reservoir during operation under low flow conditions, and have the minimum effect on the surrounding environment. The barrage is also to maintain a sufficient low salinity level near the Sasang summerbed agricultural area. Full opening of the barrage over the whole tidal cycle is not advised during river discharges lower than 700 cubic m/second. Full opening of the barrage should take place for river discharges over 1,000 cubic m/second to avoid an increase of the flooding frequency of the summerbed agricultural area. Flushing of the reservoir is advised if required to maintain a proper water quality. (Baker-IVI)
W84-04504

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - ECOLOGICAL ASPECTS,
Euroconsult, Arnhem (Netherlands).
J. C. Post.
Water Science and Technology, Vol. 16, No. 1/2, p 223-231, 1984. 4 Fig, 9 Ref.

Descriptors: *Land reclamation, *Environmental effects, Nakdong Estuary, Estuarine environment, Estuaries, Birds, Environment impact statement, Decision making.

In Korea, construction of a barrage in the mouth of the Nakdong river is planned. The barrage will be situated in a nature reserve, designated as a wintering ground for migratory birds. Construction of the barrage and the associated land reclamation area will have a negative impact on the bird population. Alternative designs and locations for the barrage and land reclamation sites have been made in order to minimize the ecological impact of the project. A compromise has been made between technical requirements and ecological desirabilities. An ecological research and management program has been drafted as a part of the barrage project. While the originally proposed site has been the one finally chosen, based on technical and economic grounds, the design has undergone changes. A discharge sluice will be constructed in the right river branch, which will enable the fresh water distribution in the estuary to be manipulated to some extent. The loss of tidal flats due to dredging will be reduced and the alteration of the original channel system minimized as much as possible. The southern tip of Eulsuk island, which will be closed from the rest of the island, could then be developed into a bird sanctuary. (Baker-IVI)
W84-04505

NAKDONG ESTUARY BARRAGE AND LAND RECLAMATION - MORPHOLOGICAL ASPECTS,
Waterloopkundig Lab., Delft (Netherlands).
W. D. Eysink.
Water Science and Technology, Vol. 16, No. 1/2, p 233-241, 1984. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Environmental effects, *Land reclamation, Estuarine environment, Estuaries, Nakdong Estuary, Siltation, Reservoirs, Dredging, Tidal flats, Saline water intrusion.

The Nakdong Estuary barrage and land reclamation project will prevent the present water losses for salt repulsion and create a small fresh water reservoir and new land for agriculture and industrial development of the Busan area. Of the various morphological consequences of the project, the most relevant will be the impacts on the remaining tidal reach and the tidal flat region. The silting of the reservoir will develop very gradually and should be counter balanced by regular maintenance dredging to avoid unacceptable extreme water levels upriver. The negative impact on the tidal flat area is temporary when no or only a modest maintenance dredging in the downstream discharge channels is applied and is the lowest with the barrage at Hadan. Full maintenance dredging to preserve the present main channel dimensions in the tidal reach would be expensive and increase the negative impact on the tidal flats and the barrier islands. A compromise could be found with the barrage at Hadan, causing acceptable extreme water levels upriver and requiring a reduced maintenance dredging in only a part of the downstream discharge channels which will induce no further adverse effects on the area of the tidal flats. (Baker-IVI)
W84-04506

WATER QUALITY ASPECTS OF THE NAKDONG ESTUARY BARRAGE,
DHV Consulting Engineers, Amersfoort (Netherlands).
J. W. van Sluis, and L. Lijklema.
Water Science and Technology, Vol. 16, No. 1/2, p 243-252, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Environmental effects, *Water resources development, Nakdong Estuary, Construction, Decision making, Estuarine environment, Estuaries, Water quality, Algal growth, Wastewater disposal, Mathematical studies.

The construction of the Nakdong Estuary Barrage will completely change the hydrological situation in the mouth of the Nakdong river. The size of the estuary will be considerably reduced. A large reservoir is to be created upstream of the barrage. Main points of interest are the effects of the discharge of raw sewage and treated effluent into the Nakdong river on the water quality in the projected reservoir and the water quality forecasts for the remaining part of the estuary, in relation with the existing plans for sewerage and sewage treatment for the city of Busan. Measures to reduce the effects of the barrage and the outline of a water quality management program are presented. Special consideration is given to the methodological aspects of the water quality study. The studies underline the importance of carrying out preliminary design and environmental analysis simultaneously. Mathematical (water) quality models used in design studies should be selected in accordance with the quantity and reliability of the available data and should be concentrated on major processes and effects. (Baker-IVI)
W84-04507

TIDAL POWER FROM THE SEVERN ESTUARY,
J. Corlett.
Water Science and Technology, Vol. 16, No. 1/2, p 253-268, 1984. 5 Fig, 14 Ref.

Descriptors: *Environmental effects, *Water resources development, Planning, Decision making, Water quality, Severn Estuary, Estuarine environment, Estuaries, Construction, Energy, Tidal powerplants.

After many years of public discussion, the British government set up the Severn Barrage Committee in 1978 to advise the Secretary of State for Energy on whether to proceed with a scheme for harnessing the tidal power of the Severn Estuary for the production of electricity. Among the 23 members of the committee, two were ecologists. Many studies were commissioned on engineering, economic, social and environmental aspects of the proposed schemes and 27 of the 106 major reports submitted to it concerned ecology, nature conservation and water quality. The reports included predictions of what might happen in the estuary if a barrage were to be built. Many reports say that the amount of data available is limited and suggest further work that needs to be done. While building the barrage has been judged to be technically feasible, the economic viability depends on the relative costs of electricity generation to other methods of obtaining energy such as nuclear power. (Baker-IVI)
W84-04508

ENVIRONMENTAL AND NATURE CONSERVATION ASPECTS OF TIDAL POWER PROPOSALS FOR THE SEVERN ESTUARY (UK),
Nature Conservancy Council, London (England).
R. Mitchell, and P. K. Probert.
Water Science and Technology, Vol. 16, No. 1/2, p 269-279, 1984. 23 Ref.

Descriptors: *Environmental effects, *Water resouces development, Tidal estuaries, Estuarine environment, Estuaries, Energy, Powerplants, Environmental impact statement, Construction.

Recent studies of tidal power generation in the Severn Estuary indicate that a single basin ebb-generation scheme would produce marked changes in the physical and chemical environment. The impact of these factors on the natural environment is reviewed. Implications for the particular features of nature conservation interest of this important estuarine area are examined and the opportunities for the amelioration of deleterious effects are discussed. The most obvious effect of a tidal barrage would be the changes in water level. Changes in water flow patterns are also examined along with sediment transport, deposition and erosion patterns. Primary productivity is discussed including zooplankton, and benthos. Waders and wildfowl, migratory fish, and marine fish were also considered. Amelioration of adverse effects is discussed. (Baker-IVI)
W84-04509

INTEGRATION OF ECOLOGICAL AND ENGINEERING ASPECTS IN PLANNING LARGE SCALE TIDAL POWER DEVELOPMENT IN THE BAY OF FUNDY, CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
D. C. Gordon, Jr.
Water Science and Technology, Vol. 16, No. 1/2, p 281-295, 1984. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Environmental effects, *Water resources development, *Tidal powerplants, Energy, Bay of Fundy, Canada, Tidal waters, Decision making.

Large-scale tidal power development in the Bay of Fundy has been given serious consideration for over 60 years. Tides in this bay are among the highest in the world. The mean tidal range is 10-12 cm and can exceed 16 m at certain times and places. Interaction between engineers and environmental scientists that has taken place over the years is reviewed. A proposed layout of a tidal power project at the mouth of Cobequid Bay is presented along with a hypothetical construction schedule for the project. The final guidelines will be transmitted to the tidal project proponent who will use them to help design impact assessment studies. These studies are short-term applied investigations which focus on specific environmental questions that must be answered. There is a need to establish a multidisciplinary research group, funded by the proponent, to conduct long term research to determine the actual environmental changes that occur, thereby testing the predictions made during the environmental impact assessment exercise. (Baker-IVI)
W84-04510

ENVIRONMENTAL CONSEQUENCES AND AMELIORATIVE MEASURES OF THE ANNAPOLIS TIDAL POWER PROJECT,
Acadia Univ., Wolfville (Nova Scotia). Dept. of Biology.
G. R. Daborn, G. C. Baker, and M. J. Dadswell.
Water Science and Technology, Vol. 16, No. 1/2, p 297-306, 1984. 4 Fig, 8 Ref.

Descriptors: *Environmental effects, *Tidal powerplants, Water resources development, Annapolis Estuary, Estuarine environment, Fish, Environmental impact assessment, Planning, Decision making, Nova Scotia.

A 7.6 m diameter straight flow turbine was installed in an existing rockfill tidal dam at Annapolis Royal, Nova Scotia. Operation as an ebb-flow generator will yield 17.8 MW at heads of 5-6 m. Environmental consequences, and changes in design and operating mode, and remedial measures required to accommodate effects on agriculture and fish passage are outlined. The process of environmental impact assessment and integration is described and discussed. When such projects are being undertaken, it is essential that proponents draw into the planning stages environmental scientists so that those studies that need conducting can be initiated, and to provide everyone with ecological insight as may already be available, when it can do the most good. (Baker-IVI)
W84-04511

ASSESSING THE ENVIRONMENTAL IMPACT OF THE ANNAPOLIS TIDAL POWER PROJECT,
Martec Ltd., Halifax (Nova Scotia).
W. G. Tidmarsh.
Water Science and Technology, Vol. 16, No. 1/2, p 307-317, 1984. 4 Fig, 12 Ref.

Descriptors: *Tidal powerplants, *Environmental effects, Environmental impact statement, Annapolis, Water resources development, Decision making, Planning, Nova Scotia, Turbines.

An 18 MW pilot tidal power project is being developed in an existing tidal barrage on the Annapolis River Estuary in southwestern Nova Scotia to evaluate the performance of a prototype STRAFLO turbine. An environmental assessment to identify potential impacts on regional biophysical and socio-economic features was completed. The assessment indicated that the most significant potential impacts of the Annapolis Tidal Power Project will be the effect on fish passage through the barrage, and interference with drainage systems on the marshlands adjacent to the estuary. The investigation showed that measures could be taken to alleviate drainage problems and assist fish passage upstream, but the concerns associated with fish mortalities in the turbine could not be answered to the satisfaction of all concerned. (Baker-IVI)
W84-04512

ENVIRONMENTAL ASPECTS CONNECTED WITH HIGH WATER PROTECTION OF VENICE,
Istituto di Ricerca sulle Acque, Rome (Italy).
R. Passino, and A. Todisco.
Water Science and Technology, Vol. 16, No. 1/2, p 319-336, 1984. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Environmental effects, *Water resources development, Coastal waters, Venice, Lagoons, Water management, Decision making, Planning.

Engineering and environmental aspects of the project for high water protection of the lagoon of Venice are described. The lagoon is 50 km long, 12 km wide, and 0.5 m deep, on the average. Man made transformations affecting the lagoon, particularly in the last fifty years, have enhanced hydrodynamic phenomena to such an extent that, in terms of high water, there has been a considerable increase in the number of days per year in which comparatively serious flooding of the lagoon-side towns occurs. Lagoon basin expansion had only a slight effect on tidal attenuation even in the case of very high tides. The possible benefit accruing from raising the ground level in dwelling areas has been evaluated in terms of increasing the level at which submergence can occur in view of the difficulties already involved in raising the level of the pavements and the canal edges. Possible advantages of movable or fixed barriers are each considered. (Baker-IVI)
W84-04513

QUANTITATIVE HYDROPHYSICAL CRITERIA OF THE EFFICACY OF RECLAMATION OF FINE-TEXTURED SOILS,
A. M. Globus, M. Sh. Nurmagambetov, and I. A. Romanov.
Soviet Soil Science, Vol. 15, No. 1, p 121-126, 1983. 3 Fig, 1 Tab, 16 Ref. Translated from Pochvovedeniye, No. 1, p 127-131, 1982.

Descriptors: *Land reclamation, *Soil properties, Soil water, Soil water potential, Soil physical properties, Pore size.

In order to develop land reclamation practices one must have objective criteria of their effect on the water-air properties of the soil. All practices for the reclamation of fine-textured soils are ultimately directed toward favorably changing the pore-size distribution. This change is reflected in a change of the main hydrophysical characteristic (MHC) of the pores. Therefore, a study of the changes in the MHC under the effect of various amendments and their amounts is a necessary part of investigations of the hydrophysical aspects of reclamation efficacy. The effect of some amendments on the MHC of a fine-textured soil, in general, and on its critical potential, in particular were studied. The concept of the critical aeration potential of swelling soils is introduced. A method is also proposed for determining the critical aeration potential and the magnitude of its change under the effect of some amendments is established. (Baker-IVI)
W84-04520

WETLAND IMPACT ASSESSMENT: PROBLEMS UNDER THE CLEAN WATER ACT,
Nelson (R. Wayne) and Associates, Inc., Boulder, CO.
R. W. Nelson.
Environmental Impact Assessment Review, Vol. 4, No. 1, p 25-40, March, 1983. 5 Fig, 13 Ref.

Descriptors: *Wetlands, *Regulations, *Environmental impact statement, Clean Water Act, Construction, Environmental effects, Water resources development, Decision making, Management, Water management.

The thrust of current change in the wetland regulatory strategy as initiated by the Army Corps of Engineers is to concentrate the government's limited resources where they are needed most, that is, where wetlands are clearly at high risk from activities normally viewed as threatening. The more costly approach calling for separate project permits, site-specific impact assessments, and routine surveillance cannot be justified from the standpoint of cost-effectiveness where the proposed activities are relatively benign. The expanding use of general permits covering these less damaging activities may have to be tempered in several ways so the ecologically valuable wetlands can still be protected, especially from the unforeseen cumulative and compounding impacts that may result from many individually low risk activities affecting the same natural system. Better documentation is called for to support the premise that activities brought under general permits really cannot generate more than minor cumulative impacts as mandated by the EPA. Greater use of the Corps of Engineers' areawide wetland review is suggested to assess cumulative effects where many similar activities are allowed under general permits within the same natural system. Instead of depending on the wetland review to uncover suspected cumulative impacts, it is suggested that the natural areas having wetlands considered unsuitable for a discharge of dredged or fill material because of their high intrinsic ecological or public interest values be identified in advance. General permits should be issued strictly on a statewide basis, or perhaps by river basin or other natural region, so critical differences around the country are not ignored. (Baker-IVI)
W84-04612

EFFECTS OF CHANGES IN DISCHARGE LEVEL ON TEMPERATURE AND OXYGEN REGIMES IN A NEW RESERVOIR AND DOWNSTREAM,
Guelph Univ. (Ontario). School of Engineering.
G. L. Mackie, J. B. Rooke, J. C. Roff, and J. F. Gerrath.
Hydrobiologia, Vol. 101, No. 3, p 179-188, May, 1983. 6 Fig, 24 Ref.

Descriptors: *Environmental effects, *Discharge hydrographs, *Discharge measurement, *Temperature, *Oxygen balance, *Dam effects, Discharge level, Guelph Lake, Ontario, Canada.

Temperature and oxygen regimes were monitored weekly in a four-year old reservoir and downstream for ten weeks during the summer (May 15 to July 30, 1979), and monthly in the fall and winter. During the summer discharge levels were changed from top to bottom in the eighth week, back to top in the ninth, all at 0.71 cu m/s (=25 cfs), and returned to the bottom in the tenth, but at 1.14 cu m/s (= 40 cfs). Changing the discharge level had little or no impact on the thermal regime within the lake or downstream at 1.14 cu m/s and only a moderate impact on water in the lake near the dam at 0.71 cu m/s bottom discharge by generating double thermoclines. Oxygen depletion rates were greatest near the surface of the lake, mainly due to temperature effects, but increased greatly at the 3 m depth, the level of the top discharge port, when discharge was changed from bottom to top. Discharge of anoxic waters through the bottom of the dam caused a drop in oxygen content immediately downstream but oxygen content returned to inflow values within 1 km downstream of the dam. (Author's abstract)
W84-04710

INFLUENCE OF WATER LEVEL DRAWDOWN ON THE FISH POPULATIONS OF CROSS LAKE, MANITOBA,
Manitoba Dept. of Natural Resources, Winnipeg. Fisheries Branch.
M. N. Gaboury, and J. W. Patals.
Canadian Journal of Fisheries and Aquatic Science, Vol. 41, No. 1, p 118-125, January, 1984. 6 Fig, 3 Tab, 19 Ref.

Descriptors: *Drawdown, *Fish populations, *Cross Lake, *Manitoba, Aquatic habitats, Reservoir operation, Environmental effects, Winterkill, Mortality, Cisco, Pike, Whitefish, Walleye.

Regulated discharges into Cross Lake, Manitoba, resulted in average summer water volumes in 1980 and 1981 that were 40% lower than preregulated volumes. Water level drawdown in the summer reduces the amount of available habitat. Consequently, the standing crops of lake whitefish (Coregonus clupeaformis), walleye (Stizostedion vitreum vitreum), northern pike (Esox lucius), and cisco (Coregonus artedii) are lower now that in preregulation and early postregulation years. Unusually early and rapid drawdown in March 1981 resulted in a severe winterkill, causing a substantial decrease in catches per unit of effort (CPUE) for most species from 1980 to 1981. The most affected species were whitefish and cisco, which showed a 50% reduction in CPUE from 1980 to 1981. The amount of fall to lake spring drawdown and the year-class strengths of coregonid fishes were inversely related. A marked overwinter drawdown reduces whitefish and cisco hatching success apparently by dewatering their spawning areas and desiccating the eggs. Low water levels in spring prevented pike and walleye access to spawning areas. (Author's abstract)
W84-04762

7. RESOURCES DATA

7A. Network Design

COST-EFFECTIVENESS OF THE STREAM-GAGING PROGRAM IN MAINE,
Geological Survey, Augusta, ME. Water Resources Div.
For primary bibliographic entry see Field 6B.
W84-04246

7B. Data Acquisition

ULTRASONIC FLOWMETERS FOR HYDROELECTRIC PLANTS,
Westinghouse Oceanic Div., Annapolis, MD.
G. P. Erickson, and J. C. Graber, Jr.
Mechanical Engineering, Vol. 105, No. 11, p 84-88, November, 1983. 3 Fig, 1 Tab.

Descriptors: *Measuring instruments, *Flowmeters, Ultrasonics, Ultrasonic flowmeters, Powerplants, Hydroelectric plants.

Ultrasonic flowmeter systems are particularly well suited for large pipes like those common to hydroelectric plants. Ultrasonic systems cause no pressure drop, require no periodic calibration, provide continuous indications of flow and are applicable to large and small pipes. They provide an accurate and continual on-line flow measurement suitable for a variety of uses ranging from turbine acceptance testing to plant monitoring. Information is offered to assist the flow measurement user in the selection of the best ultrasonic system for the application. The factors controlling performance of an ultrasonic system are discussed with an indication of how each factor influences the results. The physical requirements are dealt with and the details that must be handled in order to optimize performance are identified. Ultrasonic flow measurement systems can cover most of the spectrum of flow measurement needs at a hydroelectric plant. An ultrasonic system employing wetted transducers can provide accurate measurement at a fraction of the cost of a Gibson test to satisfy one end of the spectrum; strap-on flow measurement systems can measure those flows where better piping configurations exist, for 4-in cooling water lines to 35-ft penstocks; wetted systems can handle more com-

plex piping configurations in pipes from 12 in. to 60 ft. (Baker-IVI)
W84-04200

CROSS-DISCIPLINE HARMONY KEEPS GROUNDWATER MONITORING EFFORTS IN TUNE.
Bendix Field Engineering Corp., Grand Junction, CO.
Water Engineering and Management, Vol. 131, No. 3, p 32-34, March, 1984. 2 Fig, 5 Ref.

Descriptors: *Groundwater, *Monitoring, *Quality control, Planning, Management, Filtration, Sample preservation, Sample collection.

Groundwater monitoring is unquestionably an interdisciplinary task. The following parameters must be met in order to ensure adequate data quality: necessary well size to accommodate sampling equipment, proper sampling method, filtration procedures and proper apparatus, sample preservation methods, choice and preparation of sample containers, procedures for field measurement, and quality assurance documentation for sample collection, field analyses and chain of custody. The drilling supervisor will determine the type of drilling equipment available to perform the task, drilling additives required, methods available to prevent downhole contamination, and borehole sampling techniques available. It is the responsibility of the hydrologist to evaluate and resolve any conflicts that may exist among the requirements of the various groups needed to perform the monitoring task. (Baker-IVI)
W84-04206

WATER MANAGEMENT,
For primary bibliographic entry see Field 5F.
W84-04413

REMOTE SENSING OF SOIL MOISTURE WITH MICROWAVE RADIOMETERS,
National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
For primary bibliographic entry see Field 2G.
W84-04436

WINTER PRECIPITATION CATCH BY HEATED TIPPING-BUCKET GAGES,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. L. Hanson, J. F. Zuzel, and R. P. Morris.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1479-1480, September-October, 1983. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Rain gages, *Tipping-bucket gages, *Heated gages, *Snow, Evaporation, Thermal turbulence.

Heated-tipping bucket precipitation gages use either propane gas or electricity to heat the catchment funnel and tipping bucket mechanism so the gages can be used when the ambient air temperature is at or below freezing. Winter precipitation measured by heated tipping-bucket precipitation gages was compared to that measured by weighing-recording precipitation gages at two locations in the intermountain region of the Pacific Northwest. The heated tipping-bucket gages recorded about 30% less precipitation than the weighing-recording gages at two sites near Boise, ID and 50% less at three sites near Pendleton, OR. Probable reasons for the undercatch of these gages are: thermal turbulence transporting snow crystals away from the collector; and conditions within the collector which are favorable to evaporation of the precipitation catch. The temperature of tipping-bucket gage collectors should be maintained as low as possible to minimize the undercatch by heated tipping-bucket gages. (Moore-IVI)
W84-04476

DESIGN, INSTALLATION AND OPERATION OF A TWIN WEIGHING LYSIMETER FOR FRUIT TREES,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
M. J. McFarland, J. W. Worthington, and J. S. Newman.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 6, p 1717-1721, November-December, 1983. 5 Fig, 1 Tab, 18 Ref, 1 Append.

Descriptors: *Lysimeters, *Evapotranspiration, *Fruit trees, Peaches, Measurement instrumentation.

A large twin weighing lysimeter facility was installed at the Stephenville Agricultural Research and Extension Center, Stephenville, Texas, to measure evapotranspiration of mature peach trees. The system was designed to establish a check lysimeter so effects of irrigations or moisture stress or other treatment on the other lysimeter could be evaluated. Each lysimeter is a 2.44 m diameter cylinder 1.52 m deep. The weighing mechanisms for each lysimeter are three compression strain gage load cells with a sensitivity (hysteresis) of 4.54 kg. The load cell data from each lysimeter and on-site environmental data are automatically recorded on a micrologger with a sensitivity of 0.005 mg, which corresponds to a 4.45 kg weight. The equivalent depth of water for a sensitivity of 5 kg is 1 mm over the surface area of the lysimeter. (Author's abstract)
W84-04480

A COMPUTERIZED GROUND WATER MONITORING SYSTEM,
Insitu Consulting, Laramie, WY.
For primary bibliographic entry see Field 2F.
W84-04639

CONSTRAINTS AND CATEGORIES OF VADOSE ZONE MONITORING DEVICES,
Kaman Tempo, Santa Barbara, CA.
L. G. Everett, E. W. Hoylman, L. G. Wilson, and L. G. McMillion.
Ground Water Monitoring Review, Vol. 4, No. 1, p 26-32, Winter, 1984. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Monitoring, *Vadose zone, *Pollutant identification, Vadose water, Gravity groundwater, Groundwater, Monitoring, Water quality control, Soil properties.

A need to detect pollutants before they reach the water table has drawn interest to vadose (unsaturated) zone monitoring and brought together hydrogeologists, soil scientists and agricultural engineers who have been working in this area for years. The vadose zone is the geological profile from the ground surface to the upper surface of the principal water bearing strata. Recent studies have identified over 50 different types of vadose zone monitoring devices and methods that have optimum utility in varying hydrogeologic settings. In general, measurements made in the vadose zone are trying to define storage, transmission of liquid waste in terms of flux and velocity, and pollutant mobility. Criteria for the selection of alternative vadose zone monitoring methods are important for the development of site-specific systems. These criteria include: type of site; applicability to new, active, and abandoned sites; power requirements; depth limitations; multiple use capability; type of data collection system; reliability and life expectancy; degree of operational complexity; direct versus indirect methods; applicability to alternate media; effect on flow regime; and effect of hazardous waste on sampling or measurements. (Baker-IVI)
W84-04640

AN OVERVIEW OF COMPUTER TECHNOLOGY USED IN GROUND WATER FIELD STUDIES: PART I: BASICS,
Illinois State Water Survey Div., Champaign.
J. D. Ritchey, and M. A. Collins.
Ground Water Monitoring Review, Vol. 4, No. 1, p 33-38, Winter, 1984. 4 Fig, 13 Ref.

Descriptors: *Computers, *Groundwater, Automation, Data acquisition, Data processing, Field tests.

Consideration should be given to the use of computers when planning field studies. A foundation for determining the appropriate uses of computers in field studies is presented in two parts. This first part includes a brief description of the components that comprise a computer and is intended to clarify terminology and illustrate the general characteristics of these machines. Related and frequently used computer equipment is described in detail. Computer basics which are discussed include the central processing unit, central memory, bus, bulk storage, real-time clock, data acquisition equipment, communications equipment and software. (Baker-IVI)
W84-04641

NEW TAPE FOR GROUND WATER MEASUREMENTS,
Oil Recovery Systems, Needham Heights, MA.
P. J. Sanders.
Ground Water Monitoring Review, Vol. 4, No. 1, p 39-42, Winter, 1984. 3 Fig, 1 Tab, 5 Ref.

Descriptors: *Measuring instruments, *Water depth, *Groundwater, Monitoring, Tapes, Sensors.

The need to quickly and accurately monitor ground water parameters has led to the development of a new device, a composite tape which can be the link to various sensing devices. The tape consists of a standard steel engineering tape with two conductors at the edges of the tape, similar to a TV antenna wire. The tape coating is clear Tefzel, which has outstanding chemical and physical resistance. At the bottom end of the tape is a probe which can sense either water level by conductivity, a layer of organic liquid by an optical device, temperature by advanced seimconductor temperature transducers, pH, dissolved oxygen, absolute conductivity, or any other measurement that can be made with a small in situ probe. The steel tape itself provides one of three conductors and, because of its thin, flat shape, provides an excellent ground plane for electronic noise reduction. A multiplexing circuit commonly used in the electronics industry is placed inside the probe tip housing and routinely allows up to 16 signals to be transmitted to the hub at ground level. Most probes can be powered with a common 9V rechargeable battery. Signals are given either by low power-consuming light-emitting diodes or liquid crystal displays. This configuration allows for extremely accurate depth profiles of the desired parameters. (Baker-IVI)
W84-04642

SOME OBSERVATIONS ON FIELD EXPERIENCES WITH MONITOR WELLS,
Ground Water Sampling, Inc., Englewood, CA.
G. G. Hunkin, T. A. Reed, and G. N. Brand.
Ground Water Monitoring Review, Vol. 4, No. 1, p 43-45, Winter, 1984. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Wells, *Monitoring, *Groundwater, Water quality, Measuring instruments, Sampling.

The well is the basic sampling machine for the ground water industry and its ability to produce a truly representative sample underpins all data and conclusions. Regardless of the type of instrumentation used, a sample point that cannot be shown to be truly representative and that fails to provide a series of reliable samples over the long term is a negative investment. This review discusses features that have been found to be important in commercial, high-precision, water quality sampling in the western United States environments. In this area, water movement is slow and little or no exchange of water occurs between wells and the surrounding aquifer without artificial stimulation. Water quality stabilization requires multiple casing volume evacuations in wells ranging to 1,000 feet deep. High-volume pumping or mechanized bailing is an economic requirement. Any attempted improvement in utilization of data by mathematical processing or statistical treatment will be inadequate because samplings are infrequent and often accumulate at rates of only two or four sample suites per year. Powerful biases occur due to the failure of the sample point to eliminate false contributions to the

sample from sources other than the natural environment or a pollution source, most frequently originating in casing materials and annular seal leakage. (Baker-IVI)
W84-04643

COMPARISON OF ELECTRICAL RESISTIVITY METHODS FOR INVESTIGATION OF GROUND WATER CONDITIONS AT A LANDFILL SITE,
Lawrence Livermore National Lab., CA.
J. J. Sweeney.
Ground Water Monitoring Review, Vol. 4, No. 1, p 52-59, Winter, 1984. 11 Fig, 5 Ref.

Descriptors: *Groundwater pollution, *Landfills, *Monitoring, *California, Water pollution control, Electrical resistivity, Electrical studies, Measuring instruments, Conductivity, Geohydrology.

Two electrical methods were used and compared in the investigation of a solid waste landfill site in the central Coast Ranges of California. Terrain conductivity measurements and dipole-dipole resistivity surveys were used in support of an investigation of the hydrology and geochemistry of the site with main concerns being the establishment of baseline conditions, determination of possible contamination and design of a sampling/monitoring system. Electrical properties of rock at low frequencies are dominated by effects due to the presence of pore fluids. Differences in conductivity between saturated and unsaturated rock depend primarily on inherent electrical properties of the rock, porosity and conductivity of the fluid. Electrical detection of subsurface zones of contamination, sometimes referred to as plumes, in either the saturated or unsaturated zones requires the existence of a zone of contrasting electrical behavior produced by the contamination. In areas where materials with contrasting electrical properties are present in the subsurface with irregular geometry, anomalies can be difficult to interpret and additional information about geology and ground water conditions must be relied upon. It appeared that the two electrical methods complement each other in the investigation of local hydrologic characteristics. (Baker-IVI)
W84-04644

BATTERY OPERATED INCUBATOR FOR IN SITU PRIMARY PRODUCTIVITY STUDIES IN SMALL LAKES AND RIVERS,
University Coll., Cardiff (Wales). Dept. of Plant Science.
J. E. Furet, K. Benson-Evans, and J. E. Grey.
Hydrobiologia, Vol. 101, No. 3, p 243-245. May, 1983. 3 Fig, 10 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Measuring instruments, Incubators, Rivers, Aquatic life.

The main problem of determining primary productivity for routine phytoplankton studies in freshwater is that of changes in natural illumination. A portable, immersible incubator to measure the primary productivity of phytoplankton is described. Battery operated and inexpensive, it is designed to overcome the problem of changes in natural illumination. Tested over 3 yr, using the C-14 technique, it is now successfully used in research work on South Wales rivers. This incubator is not submersible. When used in a lake or river it can be kept in position with stones to avoid effects of excessive turbulence. It can be used on board a boat also provided that the conditions are calm during the period of incubation. Total weight of the incubator when empty is 2.4 kg, including the flex. (Baker-IVI)
W84-04715

A VERSATILE COMPUTER-CONTROLLED TRACKING AND SAMPLING SYSTEM FOR USE WITH MODEL LAKES IN TALL TUBES,
Edinburgh Univ. (Scotland). Grant Inst. of Geology.
For primary bibliographic entry see Field 2H.
W84-04755

7C. Evaluation, Processing and Publication

WATER-LEVEL RECORDS FOR THE NORTHERN HIGH PLAINS OF COLORADO, 1979-83,
Geological Survey, Lakewood, CO. Water Resources Div.
J. L. Blattner, and B. D. Rasmuson.
USGS Open-File Report 83-253, 1983. 34 p, 2 Fig, 1 Tab.

Descriptors: Water management, *Water level, *Water level fluctuation, *Colorado, Northern High Plains of Colorado, Ogallala Formation.

Water-level measurements were made in 638 wells in the winter of 1982-83, in the northern High Plains of Colorado. The water-level measurements for the winter of 1982-83 and for four preceding winters are given in a table, which also contains the location, depth, land-surface elevation and the aquifer for each well. (USGS)
W84-04245

PUMPAGE DATA FROM IRRIGATION WELLS IN EASTERN LARAMIE COUNTY, WYOMING, AND KIMBALL COUNTY, NEBRASKA,
Geological Survey, Cheyenne, WY. Water Resources Div.
C. Avery.
USGS Open-File Report 83-29, 1983. 23 p, 2 Fig, 2 Tab, 4 Ref.

Descriptors: *Pumping, Irrigation practices, *Water well data, Water distribution, Groundwater, *Wyoming, *Nebraska, *High Plains RASA, Irrigation wells.

Quantitative information concerning pumpage by irrigation wells is an integral component of the U.S. Geological Survey High Plains Regional Aquifer System Analysis. Thus, operation time, discharge rate, and irrigated acreage were measured at approximately 450 randomly selected irrigation wells within 10 areas of the High Plains during the 1980 irrigation season. The data were used to estimate the seasonal mean application of water to crops and to project total pumpage by irrigation wells in 1980 throughout the High Plains area. As part of the sampling effort, 50 irrigation wells were randomly chosen from the area of eastern Laramie County, Wyoming, and Kimball County, Nebraska. Required information was collected on only 40 of the wells. For these wells, the seasonal mean application of water on the irrigated land was 15.2 inches. For the major crop types, the seasonal mean application, in inches, were as follows: alfalfa, 19.8; corn, 15.4; potatoes, 13.8; beans, 12.8; and small grains 10.2. (USGS)
W84-04248

WATER AND STREAMBED-MATERIAL DATA, EAGLE CREEK WATERSHED, INDIANA, AUGUST 1980, OCTOBER AND DECEMBER 1982, AND APRIL 1983: UPDATING OF U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 83-215,
Geological Survey, Indianapolis, IN. Water Resources Div.
D. J. Wangsness.
USGS Open-File Report 83-532, 1983. 51 p, 2 Fig, 29 Tab, 4 Ref.

Descriptors: *Indiana, *Water quality, Organic compound, *Bottom sediments, *Hazardous materials, *Surface water, Eagle Creek watershed, Finley Creek.

Water-quality surveys within the Eagle Creek watershed were done by the U.S. Geological Survey in August 1980, October and December 1982 and April 1983 in cooperation with the city of Indianapolis, Department of Public Works. Streambed-material and water samples were collected from Finley and Eagle Creek and was analyzed for selected metals, insecticides, and acid-extractable and base-neutral-extractable compounds. Water samples also were analyzed for volatile organic compounds. The 1982-83 surveys represent different flow conditions. This report lists all the data collected and analyzed by the U.S. Geological Survey but does not interpret any of the results.
W84-04249

WATER RESOURCES DATA, MONTANA, WATER YEAR 1982: VOLUME 2. COLUMBIA RIVER BASIN,
Geological Survey, Helena, MT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-118561. Price codes: A09 in paper copy, A01 in microfiche.
USGS Water-Data Report MT-82-2, 1983. 184 p, 7 Fig, 5 Tab.

Descriptors: *Montana, *Hydrologic data, Surface water, Groundwater, *Water quality, Flow rate, *Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, *Columbia River basin.

Water resources data for the 1982 water year for Montana consist of records of stage discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 2 of this report contains discharge records for 46 gaging stations; stage/contents for 3 lakes and reservoirs; water quality for 19 stations, 3 lakes; water levels for 14 observations wells. Also included are 31 crest-stage partial-record stations and 20 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data collection programs, and are published as miscellaneous measurements. (USGS)
W84-04250

WATER RESOURCES DATA, MONTANA, WATER YEAR 1982: VOLUME 1. HUDSON BAY AND MISSOURI RIVER BASINS,
Geological Survey, Hartford, CT. Water Resources Div.
R. R. Shields, J. R. Knapton, M. K. White, M. A. Jacobson, and M. L. Kasman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-117506. Price codes: A24 in paper copy, A01 in microfiche.
USGS Water-Data Report MT-82-1, 1983. 553 p, 10 Fig, 8 Tab.

Descriptors: *Montana, *Hydrologic data, Surface water, Groundwater, *Water quality, Flow rate, *Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, *Hudson Bay basin, *Missouri River basin.

Water resources data for the 1982 water year for Montana consist of records of stage, discharge, and water quality of streams; stage, contents and water quality of lakes and reservoirs; and water levels in wells. Volume 1 of this report contains discharge records for 189 gaging stations; stage only records for 1 lake station; stage/contents for 6 lakes and reservoirs; water quality for 86 stations; water levels for 9 observation wells. Also included are 140 crest-stage partial-record stations and 33 smaller reservoirs. Additional water data were collected at various sites, not part of the systematic data collection programs, and are published as miscellaneous measurements. (USGS)
W84-04251

WATER RESOURCES DATA, CONNECTICUT. WATER YEAR 1982,
Geological Survey, Hartford, CT. Water Resources Div.
C. E. Thomas, Jr., T. B. Shepard, I. S. Gasperini, and S. E. Wing.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243899. Price codes: A15 in paper copy, A01 in microfiche.
USGS Water-Data Report CT-82-1, 1983. 327 p, 6 Fig, 2 Tab.

Descriptors: *Connecticut, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Streamflow, Flow rates, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Biological analyses, Water temperatures, Sampling sites, Water levels, Water analyses, Estuary, *Data collection.

Water Resources Data for the 1982 water year for Connecticut consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 48 gaging stations; storm discharge at 7 gaging stations; tidal volume at 1 gaging station; contents at 35 lakes and reservoirs; water quality at 39 gaging stations, 4 lakes and reservoirs, 2 harbors, 1 precipitation station, 6 partial-record stations, and 10 wells; and water levels at 59 observation wells. Also included are 41 crest-stage partial-record stations. Locations of these sites are shown on figures 4, 5, and 6. Additional water data were collected at various sites involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-04252

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1982, VOLUME 1: CENTRAL AND NORTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. G. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-118546. Price codes: A18 in paper copy, A01 in microfiche. USGS Water Data Report La-82-1, 1983. 422 p, 8 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Lower Mississippi River basin.

Water resources data for the 1982 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 77 gaging stations (including stage for 65 of these stations); stage only for 64 gaging stations and 9 lakes; contents for 1 reservoir; water quality for 104 surface-water (including 31 gaging stations), 20 miscellaneous sites, and 8 lakes, and 223 wells; and water levels for 526 observation wells. Also included are data for 209 crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering states are also included in this report. (USGS)
W84-04253

WATER RESOURCES DATA, LOUISIANA, WATER YEAR 1982, VOLUME 2: SOUTHERN LOUISIANA,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. D. Carlson, G. R. Stallworth, L. J. Dantin, and C. G. Stuart.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-229658, Price codes: A18 in paper copy, A01 in microfiche. USGS Water-Data Report LA-82-2, 1982. 404 p, 18 Fig.

Descriptors: *Louisiana, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection, Lower Mississippi River basin, Gulf of Mexico.

Water resources data for the 1982 water year for Louisiana consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This report, in two volumes, contains records for water discharge at 77 gaging stations (including stage for 65 of these stations); stage only for 64 gaging stations and 9 lakes; contents for 1 reservoir; water quality for 104 surface-water stations (including 31 gaging stations), 20 miscellaneous sites, and 8 lakes, and 223 wells; and water levels for 526 observation wells. Also included are data for 209-crest-stage and flood-profile partial-record stations. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Records for a few pertinent stations in bordering states are also included in this report. (USGS).
W84-04254

WATER RESOURCES DATA, NEW JERSEY, WATER YEAR 1982, VOLUME I: ATLANTIC SLOPE BASINS, HUDSON RIVER TO CAPE MAY,
Geological Survey, Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and F. L. Shaefer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-119726. Price codes: A15 in paper copy, A01 in microfiche. USGS Water Data Report NJ-82-1, 1983. 329 p, 7 Fig, 3 Tab. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *New Jersey, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Hudson River basin.

Water Resources data for the 1982 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume of the report contains discharge records for 77 gaging stations; tide summaries for 76 surface-water sites and 158 wells; and water levels for 49 observation wells. Also included are data for 42 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-04255

WATER RESOURCES DATA, NEW JERSEY, WATER YEAR 1982, VOLUME 2: DELAWARE RIVER BASIN AND TRIBUTARIES TO DELAWARE BAY,
Geological Survey, Trenton, NJ. Water Resources Div.
W. R. Bauersfeld, E. W. Moshinsky, E. A. Pustay, and F. L. Schaefer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-119734. Price codes: A10 in paper copy, A01 in microfiche. USGS Water-Data Report NJ-82-2, 1983. 209 p, 7 fig, 3 Tab. Prepared in cooperation with the New Jersey Department of Environmental Protection and with other agencies.

Descriptors: *New Jersey, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collections, Delaware River basin.

Water resources data for the 1982 water year for New Jersey consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume of the report contains discharge records for 21 gaging stations; tide summaries for 3 stations; stage and contents for 16 lakes and reservoirs; water quality for 58 surface-water sites and 78 wells; and water levels for 23 observation wells. Also included are data for 27 crest-stage partial-record stations, 7 tidal crest-stage gages, and 26 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS)
W84-04256

FORTRAN COMPUTER PROGRAMS TO PLOT AND PROCESS AQUIFER PRESSURE AND TEMPERATURE DATA,
Geological Survey, St. Paul, MN. Water Resources Div.
J. B. Czarnecki.
USGS Water-Resources Investigations Report 83-4051, 1983. 50 p, 4 Fig, 27 Tab, 4 Ref.

Descriptors: *Computer programs, *Data processing, *Data storage and retrieval, *FORTRAN program, Aquifer thermal-energy storage, Minnesota, Data plots.

Two FORTRAN computer programs have been written to process water-well temperature and pressure data recorded automatically by a datalogger on magnetic tape. These programs process the data into tabular and graphical form. Both programs are presented with documentation. Sample plots of temperature versus time, water levels versus time, aquifer pressure versus log time, log drawdown versus log 1/time, and log drawdown versus log time/radius squared are presented and are obtained using standard CALCOM directives. Drawdown plots may be used directly to obtain aquifer transmissivities and storage coefficients as well as leakance coefficients. (USGS)
W84-04265

BACKWATER AND DISCHARGE AT HIGHWAY CROSSINGS WITH MULTIPLE BRIDGES IN LOUISIANA AND MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 8B.
W84-04268

WATER DATA BANK (ARS) - UPDATE,
Agricultural Research Service, Beltsville, MD. Water Data Lab.
J. B. Burford, J. L. Thurman, and R. T. Roberts.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 4, p 1142-1144, July-August, 1983. 8 Ref.

Descriptors: *Data collections, *Hydrological data, Data retrieval, Watersheds, Precipitation, Streamflow.

The USDA-ARS sponsors a continuing program of watershed hydrology research. The studies have involved about 600 individual watersheds. Data summaries have been published for about 500 of the watersheds and complete data files from about 300 watersheds are stored in the water data bank, maintained by the Water Data Laboratory. Data from about 925 precipitation stations associated with the watershed studies are also included in the data bank. Procedures used to obtain, standardize, store and retrieve hydrological data collected in conjunction with the various research projects are reviewed. Data user direct-access procedures are announced. (Baker-IVI)
W84-04459

8. ENGINEERING WORKS

8A. Structures

COMPUTER MODELING OF THE CROSS CANYON CULVERT,
L. C. Rude.
Transportation Research Record 903, p 109-114, 1983. 6 Fig, 13 Ref.

Descriptors: *Culverts, *Design criteria, *Soil mechanics, Construction, Computer models, Model studies, Soil types, Pipes, Overburden.

Three different types of soil models were compared for their effectiveness in predicting the behavior of an underdesigned reinforced concrete culvert installed in a deep fill. The extended Hardin model, a linear elastic model, and two overburden-dependent models were used. The overburden-dependent model predicted the actual behavior with the least error. The analysis was performed by using the CANDE computer program. Only one construction increment was used in conjunction with a surcharge pressure applied to the top of a relatively shallow finite element grid to simulate additional overburden. The program reasonably predicted prefailure and postfailure behavior of the pipe culvert. The need to accurately represent the actual boundary condition in backfiguring overburden-dependent values was also shown. (Baker-IVI)
W84-04190

SURGE PROTECTION OF WATER SUPPLY PIPELINES FOR JUBAIL INDUSTRIAL CITY,
R. L. B. Pearce, and E. P. Evans.
Proceedings of the Institution of Civil Engineers, Vol. 76, p 249-268, February, 1984. 12 Fig, 3 Tab, 10 Ref.

Descriptors: *Protection, *Water conveyance, *Pipelines, *Jubail, Desalination plants, Design criteria, Civil engineering, Structural engineering, Water supply, Water supply development, Water treatment facility, Saudi Arabia.

The infrastructure for Jubail Industrial City will include facilities for the distribution of over 1 100 000 cu m/day of desalted seawater to both industrial complex and community. Pipes of up to 1500 mm dia. will be installed in flat terrain, the total length of pipework in the primary system being of the order of 150 km. The Paper describes the water distribution system, with storage reservoirs and pumping stations, for which most of the design work has been completed and construction has commenced. The computer program and basic data adopted for the surge analysis are discussed, together with their application to the industrial complex network, the bulk supply to the community and the suction main from the storage reservoir to the main pumping station. Plots are shown of low pressure areas occurring and of variation of transient pressures with time; critical transient pressures are shown to occur due to pump stoppage and due to the closure of valves at reservoir inlets. The surge protection measures studied and analyzed by computer include the provision of bypasses at the main pumping station, elevated tanks, air vessels, two-stage valve closure and multiple reservoir inlet valves. The control of the main pumping plant by flowmeters, make-up pumps and reservoir inlet valves is discussed. (Author's abstract)
W84-04204

THE VIEUX-PRE DAM (AMENAGEMENT DE VIEUX-PRE),
S. Alam, and R. Longuemare.
La Houille Blanche, No. 3/4, p 177-184, 1983. 5 Fig, 14 Ref.

Descriptors: *Vieux-Pre dam, *Dams, Dam design, Design criteria, Hydraulic design.

The Vieux-Pre dam, located in the East of France in the foothills of the Vosges mountains is formed by a 10 m high embankment dike. In installing the ancillary structures, some very interesting hydraulic problems had to be solved. These structures are a bottom outlet and a shaft spillway operating under a head of roughly 62 m and discharging into the same tailrace tunnel. The problem with the bottom outlet was to ensure that the outlet structure, which is a flat gate, would operate without risk of cavitation and that the downstream jet would be adequately aerated, thus allowed for free flow of the jet and the dissipation of energy along the tail-race tunnel. For the spillway, the first problem was to ensure free fall into the vertical shaft with massive induction of air to avoid all risk of cavitation and then to discharge the air in a continuous stream (without hammering) by securing a free surface flow at the outlet of the tunnel connecting the tail-race tunnel, in the neighborhood of the outlet gate chamber of the bottom outlet. The paper discusses the design hydraulic forms on a 1:20 scale-model to verify the satisfactory operation of all facilities, to estimate the air flow needed for the operation of the bottom outlet, and to ascertain the minimum slope required for free surface flow with a rapid deaeration of the emulsified air in the tunnel downstream from the shaft spillway. (Murphy-IVI)
W84-04213

SAINT-GUILLERME II. THE CLAPIER FACILITIES (REAMENAGEMENT DE LA CHUTE DE SAINT-GUILLERME II OUVRAGES DU CLAPIER),
Electricite de France, Grenoble. Groupe Regional de Production Hydraulique.
J. C. Millet.
La Houille Blanche, No. 3/4, p 185-191, 1983. 7 Fig, 21 Ref.

Descriptors: *Saint Guillerme II, *Dam design, Rehabilitation, Dam construction, Materials engineering.

Electricite de France (E.D.F.) is often confronted with the problem of the resistance of concrete aprons subjected to considerable stress, i.e. high speeds, travelling solids or the impact of spilling waves. The GRPH of the Alps region encountered this problem at the Clapier dam and opted for two approaches: a) an anti-wear granite coating: this conventional alternative relies on the resistance of granite, which has proven its value in many installations. The reinforced concrete pedestal which is part of the working structures of the dam is paved with blocks of granite equipped with instruments and sealed with cement mortar. This solution was adopted despite its cost, for apron surfaces subjected to the greatest stress. b) an anti-wear resin coating: E.D.F. has chosen to use a resin anti-wear coating for the remainder of the surface of the apron. A resinous concrete has been applied after smoothing the surface on non-plane parts with mortar. The reequipment of the St.-Guillerme II fall on the Romanche in the Isere department has made it possible to increase the harnessed rate of flow from 12 cu m/sec. to 45 cu m/sec. This necessitated the rehabilitation of the downstream basin at the 'Clapier' to transform it into a demodulation basin and stabilize to downstream rates of flow values below 30 cu m/sec. under normal operating conditions. The clapier dam thus includes a demodulated flow outlet in addition to the spillway passages. The article describes the specific approach adopted for the outlet and the facilities selected to prevent scouring downstream of the spillway. (Murphy-IVI)
W84-04214

CONTRIBUTION TO THE STUDY OF THE PROTECTION AGAINST ABRASION AND IMPACTS AFFECTING HYDRO-ELECTRIC FACILITIES (CONTRIBUTION A L'ETUDE DE LA PROTECTION CONTRE L'ABRASION ET LES CHOCS DES OUVRAGES HYDRAULIQUES),
Sika Finanz A.G., Baar (Switzerland).
J. Gentil, and J. Mousty.
La Houille Blanche, No. 3/4, p 193-199, 1983. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Abrasion, *Hydroelectric plants, Corrosion, Materials engineering, Design criteria, Materials testing, Dam design, Khashm El Girba, Sudan, Vinca Dam, Grand-Maison Dam, Chambon Dam, France.

A comprehensive introduction to problems in dam design and solutions for material usage is presented as well as the development of new techniques for use in design criteria. Abrasion and corrosion is a major concern for design criteria. The development of new materials and the improved use of conventional materials increases the options for dam design criteria. Blended concretes, corundum concretes, granite slabs and resinous mortars can protect the facilities against major repair costs. Laboratory tests (abrasion under water, adherence, impact testing) allows the quality of the materials used to be checked and provide technical results and findings. Developments of the worksites Khashm El Girba in the Sudan, the Vinca dam, Grand-Maison and Chambon in France were discussed. (Murphy-IVI)
W84-04215

DESIGN OF SPILLWAYS AND OUTLET WORKS OF SOUAPITI DAM (GUINEA) (CONCEPTION DES OUVRAGES D'EVACUATION DES CRUES ET DE VIDANGE DU BARRAGE DE SOUAPITI (GUINEE)),
Bureau d'Ingenieurs-Conseils, Paris (France).
A. Dejoux, P. Meilland, and J. Sterenberg.
La Houille Blanche, No. 3/4, p 221-230, 1983. 10 Fig, 1 Tab, 2 Ref.

Descriptors: *Souapiti Dam, *Design criteria, *Spillways, *Guinea, Dam design, Outlets, Outlet channels, Diversion tunnels, Diversion structures, Konkoure River.

The Souapiti dam project on the Konkoure in Guinea is a 130 m high earthfill dam. The development includes a free sill spillway and two provisional diversion tunnels to be used on completion of the dam as outlets for the reservoir. The free sill spillway of the Souapiti dam has a maximum flow of 4500 cu m/sec. for a head of 120 m. As the facility is called on to operate frequently, it is open to risks of cavitation, and to avoid these, the projected layout is: a very broad chute (80 meters), and installation on the chute of two deflectors for aerating the through-flow. The layouts have been studied on a 1:100 and a 1:20 scale-model. The projected outlets include tilted tunnels connected to the lower provisional diversion tunnels. Two narrows placed in each lower diversion tunnel create a jump and ensure the downstream loading of through-flows. Special measures are envisaged for the deaeration of through-flows. (Murphy-IVI)
W84-04218

RESTRUCTURING OF THE SPILLWAY OF THE DJORF-TORBA DAM (RESTRUCTURATION DU DEVERSOIR DE DJORF-TORBA),
Ministere de l'Hydraulique, Algiers (Algeria). Direction Generale de l'Exploitation.
M. S. Belouni, T. Sahraoui, J. Bouloc, and B. Goguel.
La Houille Blanche, No. 3/4, p 231-239, 1983. 12 Fig, 1 Tab, 24 Ref.

Descriptors: *Djorf-Torba Dam, *Spillways, Design criteria, Dam design, Structure, Physical properties, Stress analysis.

This large Algerian dam built near Bechar above a vast sub-Sharian catchment basin was completed in 1968. Its spillway is formed of tiered sills on a 35 m high gravity dam. It is designed to release up to 3500 cu m/sec. on to a deflector apron 100 meters wide. The reasons for the consolidation and restructuring of the facility and the consistency of the projected work are examined: apron anchored in the limestone foundations, construction of a downstream sill, further raising of the river-walls, and verification that the concrete surface is smooth and defect-free. The 1:50 hydraulic scale-model has been an invaluable tool for this study. After a few months testing, it was clear that it would not be necessary to lengthen the apron or deepen the existing cut-off. But in its present condition, there is an unacceptable risk of the floor slabs loosening. The solution will be to build a plain continuous reinforced concrete wier 2 m high at the downstream edge, and raise the existing training walls. (Murphy-IVI)
W84-04219

DETERMINATION OF PRESSURE LOSSES OF BARRAGES ON A RIVER AND PROTECTION OF THE DOWNSTREAM BED (DETERMINATION DES PERTES DE CHARGE DES BARRAGES MOBILES EN RIVIERE ET DES DI-

MENSIONS DE LA PROTECTION DU LIT EN AVAL),
Laboratoire Central d'Hydraulique de France, Maisons-Alfort.
J. Bouloc, and A. Petitjean.
La Houille Blanche, No. 3/4, p 261-274, 1983. 15 Fig, 7 Ref.

Descriptors: *Pressure loss, *Barrages, Barriers, Water pressure, Flooding, Downstream bed, Rock fill, Design criteria.

When designing barrages for navigation, the fixed part of the dam (apron, piers), must be built as substantially as possible in relation to the mobile part (obstruction), while remaining within acceptable limits of water-pressure losses during flooding (maximum admissible: 1 meter). In this regard, the various parameters causing and influencing loss of water pressure must be subjected to fine analysis. The scale-model study has yielded a set of abacuses, giving the water pressure loss for eight types of sills and various rates of flow, the height of upstream of shut-off of the apron, and the downstream water level. The study has also revealed the minimum requirements for a rockfill plane as a remedy to the erosion of the downstream bed. (Author's abstract)
W84-04223

CHAMBON DAM OPENING OF THE ORIGINAL BOTTOM OUTLET (BARRAGE DU CHAMBON OUVERTURE DE LA VIDANGE DE FOND D'ORIGINE),
Electricite de France, Grenoble. Groupe Regional de Production Hydraulique.
J. C. Millet.
La Houille Blanche, No. 3/4, p 275-279, 1983. 4 Fig, 9 Ref.

Descriptors: *Chambon Dam, *Bottom outlets, Outlets, Gravity dam, Drainage systems, Hydraulic engineering, Fouling, Mudflows.

The concrete gravity dam of Chambon was originally equipped with an outlet at altitude 951.5 meters. As the facility had become inoperative following fouling of the reservoir by mud, a new drainage was installed at level 959. The reservoir was drained at the beginning of 1980 to level 963, and the decision was taken to recommission the original outlet. The outlet was opened under a 30 m pressure. The gate was opened before the cover was blown up, and the explosion of the plug bolts was synchronized. A powerful clean-water injector was used and maintained until the reservoir had been completely emptied. The precautions made it possible to solve a problem for which twenty years ago no answer had been found. It is believed that in the future repetition of this operation at judicious chosen intervals would help prevent renewed fouling of the reservoir by mud. (Murphy-IVI)
W84-04224

NEW WATERWORKS FOR THE REDEVELOPMENT OF BAGHDAD CITY, WITH PARTICULAR REFERENCE TO THE LARGE DIAMETER TRANSMISSION PIPELINES,
For primary bibliographic entry see Field 5F.
W84-04308

A LABORATORY INVESTIGATION OF COUNTERBALANCED FLAP GATES FOR WATER LEVEL CONTROL,
Cranfield Inst. of Tech. (England).
M. G. Kay, and D. A. Ashton.
Journal of Hydrology, Vol. 71, No. 1-2, p 165-179, March 1984. 4 Fig, 7 Tab, 8 Ref.

Descriptors: *Gates, *Water level control, Design criteria, Counterbalanced flap gate, Flap gates, Water level, Canals, Irrigation canals, Channels, Developing countries.

In open channels there is often a need to control water levels within reasonably fine limits over wide ranges of flow. Gates are available which will provide the degree of control needed but they tend to be complex and expensive. A rectangular flap gate, fitted with counter-balance weights can be adjusted to control water levels in a channel under free flow conditions. The counterbalanced flap gate shows considerable promise for water level control as indicated by a model test which is described. It is simple and cheap to construct, and would be well within the manufacturing capabilities of rural workshops in developing countries. (Baker-IVI)
W84-04313

FINITE ELEMENT MODELING FOR DEPTH AND SPACING OF DRAINS IN LAYERED SOILS,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W84-04428

COST FUNCTIONS OF WATER CONVEYANCES FOR GRAVITY IRRIGATION,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4A.
W84-04452

STABILITY OF CONCRETE DAM: CASE HISTORY,
American Electric Power Service Corp., New York.
W. W. Stelle, D. I. Rubin, and H. J. Buhac.
Journal of Energy Engineering, Vol. 109, No. 3, p 165-180, September, 1983. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Dam stabiity, *Concrete dams, Claytor Dam, Floods, Limestone, Karst, Probable Maximum Flood.

Claytor Dam is located on the New River in Virginia. It was constructed between 1938 and 1941 for hydroelectric generation and it has been in service from that date. The stability of Claytor Dam was reevaluated under Probable Maximum Flood (PMF) conditions. The structure is a concrete gravity dam with a gated spillway. The foundation is karstic limestone that was treated before construction. The anchor wall at the upstream face of the dam plays an important role in structure stability. The dam was originally designed to pass 258,000 cfs (7,306 cu m/s), and was reanalyzed under PMF flows of about 1,100,000 cfs (31,149 cu m/s). At this flow, the dam is overtopped by 62.5 ft at spillway section, and 25 ft above the crest of the dam. The recognition and understanding of geologic conditions proves to be important especially when combined with the contribution of the anchor wall in the stability analyses. An attempt to evaluate bonding at the interface was inclusive. Careful drilling procedure and equipment are vital to obtaining samples suitable for testing. In a cracked base analysis the bond tensile strength at the rock concrete interface played a critical role. When bond tensile strength at the interface was neglected, the cracked base analysis indicated that the dam was unstable. (Baker-IVI)
W84-04488

NEW ROLE OF DRAINAGE SYSTEMS IN DAM STABILITY,
American Electric Power Service Corp., New York.
W. W. Stelle, D. I. Rubin, H. J. Buhac, and P. H. Anderson.
Journal of Energy Engineering, Vol. 109, No. 3, p 181-191, September, 1983. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Dams, *Stability, *Drainage systems, Drains, Maximum Probable Flood, Cracks, Pressure distribution, Stress analysis, Claytor Dam.

Foundation drains have long been used for reducing uplife pressures under masonary dams. It has been assumed that when tension develops at the heel of a dam, full headwater pressure extends for the entire tension zone. Recent studies demonstrate that foundation drains continue to function and result in significantly lower uplift pressure, causing dams to be subject to more severe loading conditions than had been considered in the design as stable. The finite element method of analysis is used to estimate the dimensions of a potential crack under a gravity structure which includes an upstream key into the foundation rock mass and internal drains. This analysis of the Claytor Dam for the PMF (Probable Maximum Flood) condition shows that the crack length stabilizes, the compression and shear stresses do not exceed the allowable stresses, and the sliding stability for the uncracked portion is adequate. In this analysis, neither any tensile bond between the concrete and foundation rock that may exist nor the sliding resistance provided by the anchor wall has been used. (Baker-IVI)
W84-04489

PROCEDURE FOR ESTIMATING SURFACE-WATER INTAKE COSTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, J. S. Condra, and K. Cable.
Journal of Environmental Engineering, Vol. 110, No. 2, p 381-391, April, 1984. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Intake costs, *Cost analysis, *Surface-water intakes, *Estimating, Estimated costs, Estimating equations, Design criteria.

Previously developed cost estimating procedures for surface-water intakes have been based primarily on a simple correlation of intake cost with one design parameter (e.g., design flow or total system cost). The cost estimating procedures correlate intake cost with a number of system components such as pipeline type and length (subaqueous or bridge-supported), bridge type (pedestrian or vehicle), and pumping requirements (pumps and pump housing). Capital and operation and maintenance costs are determined for two types of intake structures, submerged and exposed tower. Costs generated by this procedure are compared with actual project costs. The average absolute value percent error in comparing these costs is 13.9 with a range of 1.3%-26.8%. This procedure is also compared to existing cost estimating methodologies. Costs derived by the procedure presented are believed to be more accurate due to the consideration of several site-specific variables. (Murphy-IVI)
W84-04597

DAM SAFETY IN THE UNITED STATES,
R. B. Jansen.
International Water Power and Dam Construction, Vol. 36, No. 4, p 17-20, April, 1984. 3 Fig.

Descriptors: *Dam failure, *Legislation, States rights, Federal authority, Safety, Dams, Construction, Inspection, Public safety.

In recognition of the increasingly apparent problems with dams in the United States, a presidential memorandum in 1977 ordered a review of federal dam safety activities. This resulted in various reports, leading to a significant revision of practices in most federal agencies. In June 1979 the Federal Coordinating Council for Science, Engineering and Technology published the Federal Guidelines for Dam Safety which emphasized inspections to measure existing dams against current criteria; established a federal agency of dam safety offices or officers; and budgeted for implementation of the report's recommendations. Currently the role of state governments in overseeing the safety of non-federal dams is being brought into sharper focus. Most states now have laws providing for supervision, and some of these are being strengthened. Many dam safety problems have common denominators and call for cooperation among the federal and state governments and dam owners. Although federal authority over non-federal dams is limited, the national leadership must assist in ensuring public safety. (Baker-IVI)
W84-04663

UNDERGROUND MINING NEAR LARGE AUSTRALIAN DAMS,
New South Wales Dam Safety Committee, Sydney (Australia).
B. L. Cantwell, and L. M. Whitfield.

International Water Power and Dam Construction, Vol. 36, No. 4, p 20-24, April, 1984. 4 Fig, 2 Ref.

Descriptors: *Coal mining, *Dam stability, *New South Wales, *Australia, Safety, Reservoirs, Dam construction, Mining, Dam failure.

Underground coal mining is an important industry in New South Wales. Many of these mines are located under or adjacent to large dams and reservoirs. Practices currently used by the Dams Safety Committee to ensure the continuing safety of the dams and reservoirs are discussed. To date the Committee has dealt with thirty mining applications which have required some form of monitoring. These have covered a variety of mine layouts and methods of extraction, ranging from development of access headings through bord and pillar mining to longwall mining systems. In the majority of cases total extraction has been restricted to outside the marginal zone, but some partial or total extraction has been allowed under the structure and reservoir of privately owned minor dams. No mining has been allowed under a major water supply dam. The majority of mining adjacent to dams or reservoirs has taken place without effect on the security of the dam or its storage. (Baker-IVI)
W84-04664

LEGAL ASPECTS OF DAM SAFETY,
Western New England Coll., Springfield, MA. School of Law.
For primary bibliographic entry see Field 6E.
W84-04665

STORAGE LOSSES IN RESERVOIRS,
W. H. Graf.
International Water Power and Dam Construction, Vol. 36, No. 4, p 37-40, April, 1984. 5 Fig, 2 Tab, 27 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Storage loss, Design criteria, Sediment distribution, Deposition, Sediment transport, Trap efficiency, Watershed management.

It is important to be able to predict the sediment deposition, its distribution, and the storage loss which will occur when considering the design and operation of a reservoir. If sufficient data existed on the hydraulics of the deposition pattern and its volumetric storage depletion effect, it would be possible to calculate the exact storage loss. The empirical methods which have been developed for the immediate solution of the problem are examined. Storage loss measured as trap efficiency (the ability of a reservoir to trap and/or retain the sediment which enters it) will depend mainly on: the characteristics of the watershed, the water and sediment inflow into the reservoir, the reservoir's storage, and the water and sediment outflow from the reservoir. Five approaches to determining trap efficiency are considered. There are three basic techniques used for reservoir sedimentation surveys: for filled reservoirs use of sonic equipment is required, measuring primarily the reservoir bottom, and terrestrial surveying or aerial photogrammetric equipment, measuring the water surface; for empty reservoirs aerial photogrammetric equipment is used measuring the reservoir bottom; and for partly empty reservoirs a combination of the above methods is employed. The most effective control measure involves control of the watershed. Such control may be feasible on small watersheds, however, in larger ones it may be an expensive and long-term undertaking. Control of the inflow of sediment into the reservoir area can be achieved by proper watershed management and supplemented with engineering structures throughout the watershed. Control of deposition begins with the proper design of the reservoir, which must fit into the erosion-sedimentation pattern of the region. (Baker-IVI)
W84-04667

OPTIMAL DIAMETERS FOR PRESSURE PIPES OF HYDRO PLANTS,
Padua Univ. (Italy). Ist. di Idraulica.
L. Da Deppo, and C. Datei.
International Water Power and Dam Construction, Vol. 36, No. 4, p 41-44, April, 1984. 2 Fig, 2 Tab, 6 Ref.

Descriptors: *Hydroelectric plants, *Design criteria, *Pressure pipes, Linear programming, Penstocks, Tunnels, Model studies, Optimization.

A procedure is presented for determining the optimal distribution of the diameters of tunnels and penstocks for hydroelectric plants using an integer linear programming technique. The validity of the model, and a numerical example using existing equipment are discussed. Linear equality as well as linear inequality constraints can be handled by the proposed procedure. The optimal diameters are selected from those determined by common engineering practice. Cost effective criteria have been used, without the need for further definitions for cost functions of various natures and degrees of approximation. (Baker-IVI)
W84-04668

IMPROVING THE EFFICIENCY OF UTILIZATION OF HYDROBIOLOGICAL DATA IN THE DESIGN OF NEW RESERVOIRS,
All-Union Hydraulic Engineering Inst., Leningrad (USSR).
T. G. Kokoliya.
Hydrobiological Journal, Vol. 19, No. 3, p 32-34, 1983.

Descriptors: *Reservoirs, *Construction, *Decision making, Design criteria, Planning, Standards, Communication, Hydrobiological parameters.

Urgent problems of hydrobiological research and data utilization in the design of new reservoirs are discussed. The need for standardization for hydrobiological information is emphasized, and the basic problems likely to be encountered are defined. To improve the efficiency of utilization of the biological data by other specialists, the form of their presentation should be standardized on the basis of a single scale of hydrobiological parameters and units of measurement. For practical utilization the following list is suggested: list of the essential biological parameters characterizing the phenomenon under study, units of measurement; standard (or natural) magnitude, and units of its measurement; actual value of the parameters, obtained by a proven method, and units of their measurement; comparison of the values obtained with the standard values and with the temporary variability in the same parameters; assessment of the changes recorded; analysis of results taking into account other parameters and their effects; assessment of interaction; prediction of the further course of processes and changes in parameters; and conclusions and recomendations. (Baker-IVI)
W84-04730

EDV-SUPPORTED CALCULATION OF GROUNDWATER DRILLING INSTALLATIONS WITH THE GROUNDWATER DRILLING PROGRAM PACKAGE - PART 2 (EDV-GESTUTZTE BERECHNUNG VON GRUNDWASSERABSENKUNGSANFAGEN MIT DEM PROGRAMMPAKET GRUNDWASSERABSENKUNG - TEIL 2),
Ingenieurhochschule Cottbus (German, D.R.). Sektion Technologie der Bauproduktion.
J. Loeper, and U. Beims.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 3, p 100-101, March, 1983. 2 Fig, 1 Tab, 2 Ref.

Descriptors: *Computers, *Groundwater, *Drilling, Pump tests, Simulation, Pumping rate, Drainage, Costs, Wells.

The application of computer programs to two groundwater drilling projects in the German Democratic Republic is discussed. At the Great Spree Dam in Cottbus, a pump test was necessary to study soil deposition along the courses of the river. Due to unfavorable geology, the test could not be performed in compliance with the standard; therefore a simulated test using the computer program WAPRA 2 was done. The results were used to determine the position of seven wells. The computer program OPENA 1 was then applied to optimize these positions, and results suggested that only six pumps were needed. Finally the program BRUKON 2 was used after completion of drilling to optimize the pumping rate and well dimensions. The latter were reduced by 0.5 m as a result. Optimal pump output could be achieved through the use of only five pumps, decreasing energy use by 7.5 kW over the two-year life of the pumps. Cost savings were 6.5% through OPENA 1 (non-construction and operation of one well) and 5.2% through BRUKON 2 (a second well placed out of action after 20 days). At a construction site in Neubrandenburg, wells had to be dug to rid the site of groundwater. Two galleries were dug, and it was projected that one would contain 18 and the other 22 wells. Position optimization by means of OPENA 1 showed that only 14/18 wells were needed in gallery 1, so that 46 m of drilling was saved and pump output was reduced by 0.0126 cu m/sec. OPENA 1 also suggested that a total of only 414 m drilling was required as opposed to the projected 960 m. A second optimization using BRUKON 2 showed that from day 15 to the end (day 105) of operation, a 181,000 cu m reduction in water volume could be achieved by decreasing pump output (equivalent to output of one pump at 83.8 cu m/hr = 19.440 kW). BRUKON 2 suggested an optimal average well depth of 10.2 m, which was 46.8 m less than that suggested by OPENA 1. (Gish-IVI)
W84-04783

EXPERIENCES IN THE INTEGRATION OF WATER MANAGEMENT FACILITIES INTO THE LANDSCAPE USING TREES (ERFAHRUNGEN BEI DER EINBINDUNG WASSERWIRTSCHAFTLICHER ANLAGEN),
Wasserwirtschaftsdirektion Obere Elbe-Neibe (German, D.R.).
For primary bibliographic entry see Field 4D.
W84-04789

8B. Hydraulics

THIRTY YEARS OF LABORATORY STUDY OF SPILLWAYS (TRENTE ANS D'EVACUATEURS DE CRUES AU LABORATORIE),
Centre National de la Recherche Scientifique, Toulouse (France). Inst. de Mecanique des Fluides.
J. Gruat, C. Thirriot, and D. Trivellato.
La Houille Blanche, No. 3/4, p 209-220, 1983. 20 Fig, 14 Ref.

Descriptors: *Spillways, *Model studies, Hydraulic models, Model testing, Hydraulic similitude, Mathematical studies, Mathematical equations, Reynolds equation, Euler's number, Weber's number, Design criteria, Dams, Dam design.

In planning floodwater control systems all viable alternative methods of securing floodwaters should be examined. Some basic alternative methods of securing transit floodwaters is presented. Problems relating to similitude are described on the basis of scale-models studied in the laboratory. The effect of hydraulics on spillway design is then correlated. Some of the most common spillway designs include ski-jumps, mobile dams and syphon spillways. (Murphy-IVI)
W84-04217

STUDIES ON A SCALE-MODEL OF THE DEAERATION SYSTEMS USED IN WATER-PRESSURE SHAFTS (ETUDES SUR MODELE REDUIT DES DISPOSITIFS DE DEGAZAGE DANS LES PUITS DE MISE EN CHARGE),
H. Pochet.
La Houille Blanche, No. 3/4, p 241-246, 1983. 8 Fig, 9 Ref.

Descriptors: *Deaeration systems, *Water-pressure shafts, Dam design, Aeration process, Hydraulic engineering, Pressure conduits.

Water pressure shafts connecting the canals to the operational tunnels are to be found in several hydro-electric developments designed and executed by the Societe du Canal de Provence. Water dropping into pressure shafts generates air emul-

sions and it is necessary to prevent the air bubbles from entering the tunnels for reasons relating to transport capacity and stability. In one example of study using a scale-model shaft, its volume of air is large enough to release the air without need for a special device. In another case, it was necessary to build a deaeration chamber at the entrance to the tunnel. The third example is original because the solution developed comprises both a jet breaking flow and a deaeration chamber. (Murphy-IVI)
W84-04220

DIVERSION WORKS AND SEDIMENT TRANSPORT (OUVRAGES DE DERIVATION ET TRANSPORTS SOLIDES),
M. Bouvard.
La Houille Blanche, No. 3/4, p 247-254, 1983. 3 Fig, 9 Ref.

Descriptors: *Diversion tunnels, *Sediment transport, Hydraulic engineering, Diversion structures, Civil engineering, Hydraulic design, Strasbourg Dam, Rhine River, Comparison studies.

The River Hydraulics Committee of the AIRH has commissioned the author to document the best practice in the field of 'Diversion works for a river channelling solids', and to write up the 'Rules of the Art'. Although the basic hydraulic problems remain the same, the use of modern civil engineering techniques has greatly facilitated construction. By contrast, basic knowledge about materials driven by flows (bed-load and suspended substances) has not advanced much, and some of it is even being given a second look. It seems that the comparison of the results obtained or used in laboratory work and observed reality is not enough and a major effort is indispensable in this regard. Confidence in conventional formula is diminishing, and the too rare comparisons of these formula with experimental results show that they overkill. Whereas the present theory has it that serious difficulties should be encountered downstream from diversions of substantial flow (raising of the beds), they virtually never occur in practice, despite the number of books examined by the author. In his view, the explanation is that the present theories are all based on results provided by models and the hypotheses on which these models have been formulated could be inaccurate. In particular, paving phenomena - or the change in the size of the material forming the bed - could have a considerable effect on the river. The current theoretical approach to suspended substances travelling in the water is somewhat rigid, and is perhaps based on over-simplistic hypotheses. In any event, it does not allow the treatment of some fundamental aspects encountered when setting the dimension of facilities such as sand traps. (Murphy-IVI)
W84-04221

THE GUERLEDAN PUMPING STATION, (AMENAGEMENT DE GUERLEDAN),
S. Alam, and R. Longuemare.
La Houille Blanche, No. 3/4, p 255-259, 1983. 7 Fig, 5 Ref.

Descriptors: *Guerledan Pumping Station, *Design criteria, Hydraulic design, Design flow, Pumping plants.

The Guerledan development is located in Brittany, France, and consists of an energy transfer pumping station. The report gives a short account of the project and describes the problems encountered. It also discusses the 1:60 scale-model tests undertaken to design a combined intake and outlet structure which minimizes the environmental impact of the project on the reservoir. The proposed layout deals satisfactorily with the problems met. (Author's abstract)
W84-04222

MODELING STREAMLINES AND MASS TRANSPORT IN CIRCULATING FLOW,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
V. Alavian, S. M. Broeren, and D. W. Bintz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-159706, Price codes: A07 in paper copy, A01 in microfiche. Water Resources Center Research Report No. 182, October, 1983. 121 p, 37 Fig, 9 Tab, 32 Ref, 2 Append. Project No. OWRT A-112-ILL (1), Contract/Grant No. 14-34-0001-2115.

Descriptors: *Mass transport, *Mixing, Flow pattern, Circulating flow, *Dispersion, *Finite element, Analysis, Fluid mechanics.

State-of-the-art of hydraulic and water quality modeling in streams and rivers does not include the role of large, slowly circulating regions in dilution and transport of effluents discharged in such water bodies. Examples of circulating regions include meander, blocked arms of the stream, and flow behind engineering structures such as jetties, wing dams and bridge piers. Numerical schemes have been developed to simulate streamline patterns and mass transport within a circulating region approximated by a square cavity on the side of a channel. The circulating flow is assumed two-dimensional (depth averaged) and is generated and maintained by a known main flow at the open boundary. The equation governing mixing and transport of a finite quantity of conservative tracer instantaneously introduced at any location in the flow field has been numerically solved by finite element approximation. Flow geometry is represented by triangular elements, and a linear basis function is used in the interpolation scheme. The unsteady term is approximately by finite differencing in full-forward time steps. Dispersion coefficient has been represented as a tensor, the components of which are functions of the dispersion coefficients along and normal to the streamlines.
W84-04229

BACKWATER AND DISCHARGE AT HIGHWAY CROSSINGS WITH MULTIPLE BRIDGES IN LOUISIANA AND MISSISSIPPI,
Geological Survey, Jackson, MS. Water Resources Div.
B. E. Colson, and V. R. Schneider.
USGS Water-Resources Investigations Report 83-4065, 1983. 39 p, 10 Fig, 5 Tab, 16 Ref.

Descriptors: *Backwater, *Flow profiles, *Discharge measurements, Data collection, Open-channel flow, Mannings equation, Multiple bridges, Gradually varied flow, Energy losses, Indirect discharge measurement, Bridge backwater data, Floods, Bridge backwater computation, *Louisiana, *Mississippi.

Data were collected for nine floods in Mississippi and Louisiana at eight stream crossings having two to six separate bridge openings. Discharge through each bridge, water surface profiles, valley cross sections, and bridge geometry were measured. The multiple openings were divided into equivalent single-opening cases by apportioning interior embankments in direct proportion to the area of openings on either side. Using existing procedures for computer discharge, the bias in computed discharge was 2 percent with a root mean square error of 18 percent. Backwater was computed by two current U.S. Geological Survey methods that use the average flow path in the friction loss term for the approach. One method gave a root mean square error of 0.34 ft. with a bias of -0.25 ft., suggesting that the method underestimates backwater. The other method gave a root mean square error of 0.39 ft with a bias of -0.03 ft. The results indicate that the method developed for single-opening highway crossings can be applied to the multiple bridge crossings. (USGS)
W84-04268

FLUID MECHANICS - A NEW EQUATION IN STABILITY OF UNCONFINED FLOWS,
M. Bouthier.
Comptes Rendus des Seances de l'Academie des Sciences Serie II, Vol. 296, No. 17, p 1293-1296, May 9, 1983. 14 Ref.

Descriptors: *Fluids mechanics, *Unconfined flow, Hydrodynamic stability, Mathematical equations, Hydrodynamics, Stability analysis.

In the field of hydrodynamic stability several amplitude equations have been put forward to study various linear of non linear interactions. In the case of unconfined flows, these equations are proved to allow for modifications and have to be coupled with another new equation. (Author's abstract)
W84-04286

HYDRAULIC GRADIENTS NEAR SUBSURFACE DRAINS AND SOIL EROSION,
Rijksstation voor Landbouwtechniek, Merelbeke (Belgium).
W. Dierickx.
Transactions of the American Society of Agricultural Engineers, Vol. 26, No. 5, p 1409-1412, September-October, 1983. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Hydraulic gradient, *Subsurface drains, *Soil erosion, Sand, Radial flow, Electrolytic models, Pipes, Permeable envelopes, Soil particle movement.

In cohesionless sandy soils, high hydraulic gradients may cause soil particle movement into subsurface drains. In unstable structured soils, high hydraulic gradients may lead to aggregate deterioration and soil erosion. For the radial flow case and given design criteria, hydraulic gradients can theoretically be derived near ideal drains and, using the concept of effective radius, near real drains with and without envelope materials. Simulation of symmetrical radial flow towards full flowing drains by means of an electrolytic model showed that high hydraulic gradients occur in the vicinity of the drain circumference. These high gradients are responsible for soil particle movement. A larger diameter pipe only results in a slight decrease of the gradient. The use of voluminous permeable envelopes is the most effective way to reduce the hydraulic gradient and the risk of soil particle invasion. Unsymmetrical radial flow results in still higher hydraulic gradients but also in this case the hydraulic gradients can be reduced by using suitable envelope material. (Moore-IVI)
W84-04466

THE EROSIVE EFFECTS INDUCED BY BOAT PROPELLERS ON THE BOTTOM AND EMBANKMENTS OF WATERWAYS (EFFETS EROSIFS DES JETS D'HELICE DE BATEAU SUR LES FONDS ET LES TALUS DES VOIES NAVIGABLES),
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 2J.
W84-04651

INFLUENCE OF CAVITATION ON NOISE IN MODERN HYDROSTATIC CIRCUITS (INFLUENCE DE LA CAVITATION SUR LE BRUIT DANS LES CIRCUITS HYDROSTATIQUES ACTUELS),
Poclain, Le Plessis-Bellevill (France).
L. Martin.
La Houille Blanche, No. 7/8, p 537-540, 1983. 1 Fig, 7 Ref.

Descriptors: *Cavitation, *Noise, Design criteria, Hydraulic valves, Hydraulic design, Hydrodynamics, Flow characteristics, Comparison studies.

Noise due to cavitation in the flow of hydrostatic high pressure systems is of high frequency (4,000 to 20,000 Hertz) and at levels around 20 dB (linear or balanced). Even when compared to other noises occurring in hydraulic plants (friction, vibration, discharge...) it remains difficult to eliminate especially when important pressure drops are needed for operation of the circuit. More effective design criteria are presented so the frequencies can be pushed beyond the audible zone. (Murphy-IVI)
W84-04654

8C. Hydraulic Machinery

ENERGY RECOVERY USING HYDRAULIC TURBINES IN DEEP UNDERGROUND MINES,
Foster-Miller, Inc., Waltham, MA.
R. N. Torbin, and E. B. Thimons.

Mechanical Engineering, Vol. 105, No. 4, p 57-61, April, 1983. 5 Fig.

Descriptors: *Turbines, *Hydraulic equipment, *Mines, *Hydroelectric power, Cooling water Energy, Water pressure, Mechanical energy, Thermal energy.

Mines are decending to greater depths in the search for minable deposits, but the high temperatures and humidities encountered at these depths make the working environment difficult to maintain. Large quantities of water must be carried down long vertical pipelines to be use for refrigeration. Current practice allows the service and cooling water entering the mine shaft to free fall to the desired depth, where the potential energy is dissipated by friction and momentum transfer. The use of this high pressure water to operate a turbine can result in three benefits to mines: the turbine will generate a significant amount of power, it also generates thermal energy savings equal to the recovered mechanical energy, thus reducing mine refrigeration needs, and it provides a necessary water pressure reduction. The savings from the energy recovered and from the reduced refrigeration needs can pay back the initial investment in an energy recovery system in less than three years in many mine situations. (Baker-IVI)
W84-04198

BULK WATER FLOW TO POWER MARINE BEACONS,
University of Strathclyde, Glasgow (Scotland). Dept. of Thermodynamics and Fluid Mechanics.
A. D. Grant.
Journal of Energy Engineering, Vol. 109, No. 3, p 142-151, September, 1983. 6 Fig, 3 Tab, 4 Ref.

Descriptors: *Hydroelectric power, *Beacons, *Rotors, Generators, Water power, Rivers, Estuaries.

It is possible to generate power by immersing rotors into the otherwise unimpeded flow in a river, estuary, or tidal channels. A solitary submerged rotor will behave in much the same way as a windmill, and will be subject to the same constraints upon its performance. The power density in bulk water flow is generally very low, and large rotor areas are required is a substantial output is necessary. There are, however, applications where localized power sources of modest output are needed. An immersed rotor of the Savonius type used to drive an electrical generator will, given a reasonably efficient generator, enable navigation beacons to be self sustaining in flows with a mean velocity of 1.6 ft/s or higher. A large number of present buoy sites meet this requirement. The rotor used should be immune to the effects of marine growth and should not be prone to fouling. It appears the use of ducting may give a substantial improvement in performance. (Baker-IVI)
W84-04487

ICE POND COOLING SYSTEM FOR POWER PLANTS,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
A. C. Miller, J. A. Pena, J. Urbsanski, and S. N. Kerr.
Journal of Energy Engineering, Vol. 109, No. 3, p 201-206, September, 1983. 2 Fig, 5 Ref.

Descriptors: *Cooling ponds, *Powerplants, *Ice pond cooling, Ice, Pennsylvania, Nuclear powerplants, Cooling water.

A feasibility analysis is reported of the engineering and economical possibilities of a power plant using melting ice to cool the condenser effuent as an alternative approach. In order to designate specific design criteria, the ice pond cooling scheme was theoretically applied to a 1,000 MW nuclear power plant that requires a constant condenser cooling water flow of 1,337 cfs. The study indicated such a plant is indeed feasible and has produced a practical conceptual design for a large ice water sink based primarily on fundamental engineering principles. Analyses conducted in the areas of ice time history and plant performance have shown that the ice required for year round cooling can be readily produced in northern Pennsylvania and effectively used in such a scheme with the possibility of increasing plant output due to more favorable condenser conditions resulting from the cooler water that is made available. The following benefits of the scheme are noted: extremely low evaporative losses, increased plant efficiency, no required blowdown scheme, and the provision of a reservoir sufficient in size to comply with power plant cooling requirements. (Baker-IVI)
W84-04490

CHOOSING PUMPS FOR WATERWORKS,
W. C. Krutzch.
Water Services, Vol. 88, No. 1057, p 93-94 and 97, March, 1984. 3 Fig, 4 Tab, 1 Ref.

Descriptors: *Pumps, *Efficiency, Design criteria, Water distribution, Efficiency.

As energy costs have escalated in recent years, pump users have become more and more aware of the fact that the cost of operating a pump over its lifetime will usually be many, many times its purchase price. Efficiency is of paramount importance. To assure the selection of pumps which will provide maximum efficiency it is first necessary to consider specific speed. For any given combination of capacity and head, specific speed is directly proportional to pump speed, and higher values of the former can only be achieved by increasing the latter. High specific speed pumps are less suited to waterworks services than optimum specific speed designs, aside from any disadvantage they might have in efficiency. Because of the importance attached to both operating efficiency and reliability, it has been a long standing practice in waterworks systems to use multi-pump installations. Reliable achievement of maximum efficiencies requires a conservative approach to impeller inlet design, and to that extent, specifications which recognize that fact are more likely to generate proposals which offer good efficiencies. (Baker-IVI)
W84-04560

THE DEVELOPMENT OF HIGH POWER HYDRAULIC TURBOMACHINES (LE DEVELOPPEMENT DES TURBOMACHINES HYDRAULIQUES DE GRANDES PUISSANCES),
Neyrpic, Grenoble (France).
S. Casacci, and G. Caillot.
La Houille Blanche, Vol. 7/8, p 475-484, 1983. 7 Fig, 3 Ref.

Descriptors: *Turbines, *Hydraulic turbines, *Pump turbines, Performance evaluation, Fluid mechanics, Hydraulic properties, Design criteria, Hydraulic machinery, Hydraulic design, Computers.

Hydraulic turbines are being developed in a number of industrial sectors. Typical for this development is the increase in unit power rating, which reaches 800 MW in one case of turbines and 500 MW for turbine pumps, coupled with an extremely high level of performance. This paper examines how this progress has been achieved by application of the latest knowledge in fluid mechanics and structural mechanics and by development of new production methods. The possibilities opened by the computer-assisted design are also considered. (Author's abstract)
W84-04650

AN EXPERIMENTAL APPROACH TO THE VIBRATORY AND ACOUSTIC PROBLEMS INVOLVED IN FAST PUMPS. AN EXAMINATION OF THE HYDRO-ELASTIC PHENOMENA (APPROCHE EXPERIMENTALE DES PROBLEMES VIBRATOIRES ET ACOUSTIQUES POSES PAR LES POMPES RAPIDES. MISE EN EVIDENCE DES PHENOMENES HYDROELASTIQUES),
Neyrpic, Grenoble (France).
J. C. Guilloud, A. Bonazzi, B. Garnier, and J. C. Bouricot.
La Houille Blanche, No. 7/8, p 521-524, 1983. 4 Fig.

Descriptors: *Pumps, *Pump testing, *Acoustics, *Hydraulic properties, *Hydro-elastic phenomena, *Fast pumps, Hydraulic machinery, Flow velocities, Hydrodynamics, Noise.

Pump vibration must be diminished if the noise emission of a cycle is to be reduced. The present paper highlights the effects of inertia, stiffness and damping produced by the fluid transported. It shows how modification in critical speeds produced by interaction of fluid and pump rotor are generally important (changing individual frequencies, the existence of high damping values). In the near future it will probably become possible to determine these critical speeds in function of the fluid transported and modify them in order to avoid structural resonance and thereby eliminate one of the major causes of noise emitted by a circuit. (Author's abstract)
W84-04653

DYNAMIC BEHAVIOUR OF SAFETY BUTTERFLY VALVES,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. Ellis, and W. Mualla.
International Water Power and Dam Construction, Vol. 36, No. 4, p 26-31, April, 1984. 11 Fig, 2 Tab, 1 Ref.

Descriptors: *Dam construction, *Valves, *Butterfly valves, Safety valves, Pipelines, Turbines, Design criteria, Hydroelectric plants.

In hydroelectric powerplant applications, butterfly valves are designed as safety devices, and a primary feature of their operation is that they should close automatically in a safe manner in the event of a pipe rupture or turbine failure. How the closing characteristics of the valves depend on the amount of external torque applied and the properties of the damping mechanism is described. The five cases considered illustrate clearly that, in the event of pipe rupture, different closure curves of the safety butterfly valve can be obtained depending on the amount of external torque applied and the properties of the damping mechanism. The values of the external weight and the ratio of the area of the piston to the area of the opening can be optimized depending on the maximum allowable head on the upstream side of the valve and in the surge tank. (Baker-IVI)
W84-04666

8D. Soil Mechanics

COMPUTER MODELING OF THE CROSS CANYON CULVERT,
For primary bibliographic entry see Field 8A.
W84-04190

ARAB POTASH SOLAR EVAPORATION SYSTEM: DESIGN AND DEVELOPMENT OF A NOVEL MEMBRANE CUT-OFF WALL,
For primary bibliographic entry see Field 3A.
W84-04202

LESSONS TO BE LEARNT FROM AN EMBANKMENT FAILURE,
D. M. Finlayson, J. R. Greenwood, C. G. Cooper, and N. E. Simons.
Proceedings of the Institution of Civil Engineering, Vol. 76, p 207-220, February, 1984. 9 Fig, 7 Tab, 8 Ref.

Descriptors: *Embankments, *Embankment failures, Performance evaluation, Construction methods, Construction, Foundation failure, Structural engineering.

In June 1981, a 10 m high embankment constructed for the northern sector of the M25 orbital motorway failed shortly after completion of the bulk earthworks. The factor of safety calculated by conventional slip circle analysis in terms of total stress was in excess of 2 at the time of failure. The scope of the site investigations is set out, together with details of the analyses carried out; these lead

to various conclusions concerning the reasons for failure. To minimize disruption to the contract, remedial works had to be specified at various points in time. All of these aspects are examined in the context of the present state of technical knowledge, in order to derive lessons to be learned from the incident. The construction contract included several features which were departures from existing practice for embankment construction in clay soils. The drainage mat was placed on undisturbed ground, and had the secondary function of facilitating the movement of plant. A drainage mat can disguise the presence of a weak foundation which otherwise would rut under the movement of plant. One lesson is to limit the rate of placing. This has the additional benefit of precluding the use of large plant fleets of very high production rate. The final lesson is to use benching on sloping ground either laterally or longitudinally. Instabilities or weak zones which develop due to the weathering of soils tend to do so parallel to the ground surface. Benching neatly intersects these in manner which precludes the existence of extensive layers of weak strength immediately below an embankment. (Murphy-IVI)
W84-04203

FAILURE OF PORE-WATER ANALYSES FOR DISPERSION,
Bureau of Reclamation, Denver, CO.
C. D. Craft, and R. G. Acciardi.
Journal of Geotechnical Engineering, Vol. 110, No. 4, p 459-472, April, 1984. 5 Fig, 7 Tab, 10 Ref.

Descriptors: *Soil pore-water analysis, *Dispersion, *Soil porosity, Comparison studies, Performance evaluation, Soil properties, Soil engineering, Soil classification, Clayey soils, Analysis of variance.

Due to the potential loss to life and property resulting from catastrophic failure of earthen structures constructed with dispersive clay soils, there has been increasing interest in developing reliable physical and chemical tests to identify dispersive soils. The method of Sherard and coworkers ('currently accepted method') where soil saturation extract cation data are plotted on a percent sodium versus TDS (total dissolved solids in milliequivalents per liter) graph to classify clayey soils as dispersive or nondispersive, is applied to 223 soil samples from six different soil groups. The method exhibited poor overall agreement with physical test results. These data were subsequently evaluated using analysis of variance and discriminant analysis (a multivariate classification technique) which indicated that each soil group exhibits unique classification criteria based on pore-water cation data. It appears that, for most soil groups in this study, pore-water cation data do not provide adequate identification of dispersive and nondispersive clay soils. Reasons for the observed lack of agreement between pore-water data and physical tests are reviewed and suggestions for further research are presented. (Murphy-IVI)
W84-04601

8E. Rock Mechanics and Geology

ANTI-WEAR COATINGS OF THE RHONE DAMS (LES REVETEMENTS ANTI-USURE DES BARRAGES DU RHONE),
J. Mamet, N. Llopis, and A. D'Angelo.
La Houille Blanche, No. 3/4, 201-207, 1983. 6 Fig, 2 Tab, 1 Ref.

Descriptors: *Anti-wear coatings, *Coatings, *Rhone River, *Dams, Design criteria, Materials engineering, Concrete additives, Aprons, Piers, Resins.

Between 1952 and 1982, the National Company of the Rhone, in its development program for the river, built 16 reservoir dams equipped with sliding or sector gates. The aprons and piers are protected by anti-wear coatings. The granite rubble once used has given way to cement-corundum coatings which have in turn been replaced by synthetic resin coatings and concrete. Two types of protection were discovered and used for the first time at the Villeneuveles-Avignon dam. Epoxy-corundum tar pitch-resin coating has a thickness of 2 cm and is applied to a concrete surface which has undergone the necessary preparation. This compound is as resistant to wear as any high-grade granite. A resin-concrete coating is used in certain zones of dam aprons which are subject to vibrations or cavitation. The composition of this concrete is as resistant to wear as low-grade granite. Protection against impacts has also been examined. As a result, so-called simple formulations have been specified and their resistance to wear is mostly equivalent to that of soft steel. The least costly protection, epoxy-corundum tar pitch-resin coating plus resin concrete, adopted for the St-Pierre de Boeuf dam represents approximately 8% of the amount of civil engineering work of the facility. The diversification of the types of protection is specific to the design and operation of the mobile dams on the Rhone. The choice of the type of protection is subordinate to the parameters pertaining to each dam and the efficiency associated with the quality of the methods used for their construction and control. (Murphy-IVI)
W84-04216

EVALUATION OF THE RISK OF INDUCED SEISMICITY AT THE ITZANTUN HYDROELECTRIC SITE, CHIAPAS, MEXICO,
Alberta Univ., Edmonton. Dept. of Physics.
A. Uribe-Carvajal, and E. Nyland.
Engineering Geology, Vol. 19, No. 4, p 247-259, December, 1983. 7 Fig, 1 Tab, 33 Ref.

Descriptors: *Induced seismicity, *Dam effects, *Earthquakes, *Itzanrun, *Mexico, Reservoir filling, Drawdown, Geologic fractures, Thrust faulting, Hydroelectric plants, Tectonic stress.

Consolidation theory and concepts of rock failure can be used to evaluate the probable risk of induced seismicity as a result of filling of reservoirs. This evaluation indicates the safest way to fill a reservoir, and depends only on the geometry of the load, the rate of filling and the geological structures in the area. The stability function is actually a measure of the risk of having failure, with time, for a particular loading history in respect to a plane of weakness. The stability function is applied to the area of the Itantun reservoir, which will be in southern Mexico. Drawdowns can increase the risk of triggering earthquakes in this area, which is prone to thrust faulting. It is possible to estimate the stresses after a period during which the water level is maintained and a decrease in stresses with the depth of the observation point. The estimates of the probable induced seismicity are limited as the residual stress in the area prior to the impoundment is unknown. With a measure of the residual tectonic stress it will be possible to determine an optimal filling rate to reduce the probability of induced seismicity. (Author's abstract)
W84-04365

8F. Concrete

CALTRANS PRESTRESSED CONCRETE PIPE CULVERT RESEARCH: DESIGN SUMMARY AND IMPLEMENTATION,
A. E. Bacher, A. N. Banke, and D. E. Kirkland.
Transportation Research Record, No. 903, p 95-99, 1983. 16 Fig, 2 Ref.

Descriptors: *Design criteria, *Pipes, *Concrete, *Culverts, Prestressed concrete, Pressure pipes, Drainage, Earth load.

A summary of the design and implementation of a research project on the use of prestressed concrete pipe in culverts is presented. The research installation has 96-in prestressed concrete pipe culvert under 200 ft of overfill. The following design summary conclusions were made: Method A (compacted structure backfill) loadings of 140V:140H and 140V:42H are adequate; fill heights versus soil pressures were approximately linear; there was excellent correlation between theoretical and experimental moments, thrusts, and displacements; the 96-in prestressed pipe was grossly overdesigned; and earth load stresses are additive to those from prestressing. The primary use of prestressed pipe in the area has been for pressure pipe installations, specifically special drainage designs. Prestressed concrete continues to offer an acceptable alternative for special drainage designs, that is, where there is an unstable soil condition in a potential slide area. Under high fills it is not recommended, since there is admittedly the adverse effect of the earth loads being added to the prestressing forces. (Baker-IVI)
W84-04188

8G. Materials

EFFECT OF HEAVY LOADS ON BURIED CORRUGATED POLYETHYLENE PIPE,
R. K. Watkins, R. C. Reeve, and J. B. Goddard.
Transportation Research Record 903, p 99-108, 1983. 14 Fig, 4 Tab, 3 Ref.

Descriptors: *Corrugated polyethylene pipe, *Load distribution, Soil pressure, Pipes, Conveyance structures, Performance evaluation.

Corrugated polyethylene pipe, developed originally in 4- to 12-in diameters for land drainage, is now manufactured in larger diameters for other uses of buried conduits such as culverts, air ducts, and service conduits. Tests were conducted on pipes with 15-, 18- and 24-in inner diameter to investigate the structural performance and performance limits of these larger-diameter pipes when subjected to external soil pressures. For pipes in typical native soil backfill, compacted by typical methods to greater than 80 percent standard density (AASTHO T-99), less than 1 ft of soil cover (called minimum cover) was found to be adequate protection against H-20 (32-kip/axle) loads and up to 54-kip/axle 'super-loads'. The soil envelope does not have to be select material. At less than minimum cover, the performance limit is either (a) excessive pipe deflection or (b) localized reversal of curvature directly under the wheel load. Under high soil cover, both the performance and performance limit are pipe deflection (out-of-roundness), which is a function of the total vertical soil pressure and is equal to slightly less than vertical-soil strain in the backfill material on both sides of the pipe, herein referred to as sidefill. In compacted soil backfill, pipe deflection is less than 10 percent for either H-20 loads on minimum soil cover or vertical pressure up to 2500 psf under high soil cover. Pipe stiffness is roughly equal to steel and is greater than aluminum in 16-gage, 2-2/3 x 1/2 corrugations. (Author's abstract)
W84-04189

USE OF LINERS FOR CONTAINMENT AT HAZARDOUS WASTE LANDFILLS,
EMCON Associates, San Jose, CA.
F. Cope, G. Karpinski, J. Pacey, and L. Steiner.
Pollution Engineering, Vol. 16, No. 3, p 22-32, March, 1984. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Landfills, *Hazardous materials, *Linings, Design criteria, Legislation, Groundwater protection, Waste disposal, Economic aspects, Leachates, Water pollution prevention, Plastics, Polymers.

In spite of the growing interest in the use of synthetic liners to contain wastes, there is still some skepticism concerning their ability to protect groundwater over the long term. The pollution engineer must exercise considerable judgement in selecting and designing a liner system for a landfill, particularly a site designated to accept hazardous wastes. State-of-the-art design criteria are offered for liners at hazardous waste landfills. The necessary steps needed to meet the requirements for both natural and synthetic liners delineated in Subtitle C of the Resource Conservation and Recovery Act (RCRA) are noted. Selection of an appropriate liner should be based upon the performance required. Major selection criteria for liners include performance, waste compatibility, site conditions and environmental factors. Two critical pre-design activities that the designer must undertake are an assessment of the impact of waste composition on

liner selection, and an evaluation of site conditions that could impact liner performance. Landfill base liner systems should consist, at a minimum, of a primary liner of synthetic material, and a leachate collection and removal system. If final cover will not be applied for 30 years or more, the liner system is more complex, consisting of: primary liner of synthetic material; primary and secondary leachate detection, collection, and removal system; and a secondary liner of clay soil or synthetic material. Factors to be considered in estimating the capital costs of a lined hazardous waste unit include: type of liner material; location of facility; facility size; site conditions; and economic factors. (Baker-IVI)
W84-04201

ANTI-WEAR COATINGS OF THE RHONE DAMS (LES REVETEMENTS ANTI-USURE DES BARRAGES DU RHONE),
For primary bibliographic entry see Field 8E.
W84-04216

8I. Fisheries Engineering

A FISH POPULATION MODEL FOR IN-STREAM FLOW ASSESSMENT,
Pennsylvania State Univ., University Park. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W84-04238

BABINE LAKE SOCKEYE SALMON (ONCORHYNCHUS NERKA) ENHANCEMENT PROGRAM: TESTING SOME MAJOR ASSUMPTIONS,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
J. McDonald, and J. M. Hume.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 41, No. 1, p 70-92, January, 1984. 7 Fig, 20 Tab, 27 Ref, 1 Append.

Descriptors: *Babine Lake, *British Columbia, *Salmon, Fisheries engineering, Spawning channels, Flow control, Fish management.

The objective of the Babine Lake sockeye salmon (Oncorhynchus nerka) enhancement project was to increase fry outputs (and thus, smolt outputs and adult returns) by expandng and improving available spawning beds through the use of artificial spawning channels and related water flow control facilities. The project proceeded on four basic assumptions: (1) the artificial spawning channels would prove an effective means of producing sockeye fry, (2) the fry produced would be as viable as those produced from natural spawning beds, (3) the lake nursery area had the capacity to support larger juvenile populations, and (4) increased smolt outputs would result in increased adult returns. A before and after study has allowed these assumptions to be tested. Egg-to-fry survival in the channels was close to 40%, as expected. Comparisons of wild and channel-produced fry did not reveal any substantial difference in their distribution, growth, and survival in the lake. Increases in the abundance of fry were followed by corresponding increases in the abundance of underyearlings in the lake and seaward migrating smolts. No significant change in the average size of the juveniles or their survival in the lake could be detected when population size increased. While the assumptions regarding juvenile production were found to be generally valid, adult returns did not meet expectations. This was due largely to the lack of response to increased smolt outputs from even-numbered brood years. Some options for future management are offered. (Author's abstract)
W84-04761

10. SCIENTIFIC AND TECHNICAL INFORMATION

10B. Reference and Retrieval

INSTRUCTIONS FOR USING THE U.S. GEOLOGICAL SURVEY DATA BASE OF WELLS ON LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
G. W. Hawkins, and G. M. Terlecki.
USGS Open-File Report 82-568, 1983. 189 p, 16 Fig, 48 Tab, 2 Ref.

Descriptors: Algorithms, *Computer programs, *New York, Data collections, *Well data, Long Island, Minicomputers, FORTRAN programs.

The population of central and eastern Long Island, New York depends on ground water for its supply of fresh water. Data on more than 7,500 wells on the island have been collected by various State and local agencies and compiled by the U.S. Geological Survey since 1906. During 1975-81, the Geological Survey developed a data base for its Data General Nova 1220 minicomputer to store and process the well information. The data base is composed of seven sections, each of which may be revised and updated. Three types of magnetic devices with limited capacity are used for data storage--disk, Linctape, and 9-track tape. This breakdown makes each section small enough to store and update on a small minicomputer while allowing simultaneous data retrieval from all sections. This manual gives complete instructions for revising, storing, and retrieving well data. Most programming is in FORTRAN, but some is in assembly language. (USGS)
W84-04247

10C. Secondary Publication And Distribution

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN SOUTH DAKOTA, PROJECT STATUS SUMMARY, JULY 1, 1983,
Geological Survey, Helena, MT. Water Resources Div.
E. F. LeRoux, and E. M. Decker.
Available from the Ofss, USGS, Box 25425, Fed. Ctr. Denver, CO 80225. USGS Open-file Report 83-754, July, 1983. 41 p, 3 Tabs.

Descriptors: Hydrologic data, *Water resources studies, Documentation, *South Dakota.

Project descriptions and lists of hydrologic-data stations are presented to show the status of the U.S. Geological Survey water-resources studies in South Dakota. (USGS)
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 17, NUMBER 12
DECEMBER 1984

W84-04793 -- W84-05367
CODEN: SWRABW

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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VOLUME 17, NUMBER 12
DECEMBER 1984

W84-04793 -- W84-05367

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

THERMAL DEPENDENT PHYSICAL PROPERTIES OF WATER,
New Mexico Univ., Albuquerque. Dept. of Civil Engineering.
R. J. Heggen.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 298-302, February, 1983. 2 Tab, 4 Ref.

Descriptors: *Water, *Physical properties, *Temperature effects, Viscosity, Fluid mechanics, Mathematical equations, Hydraulic engineering, Specific heat, Density, Surface tension, Vapor pressure.

A set of empirical equations is presented for six fundamental properties of water: dynamic viscosity; mass density; isobaric specific heat; isothermal compressibility; surface tension; and vapor pressure. These six properties are commonly taken as fundamental properties in engineering fluid mechanics. The equations represent an analytic middle ground, less lengthy than their counterparts in the physical literature, but describing thermal dependence with precision equaling or exceeding the accuracy associated with most engineering calculations. The constants and functions given provide useful estimators for these properties. These estimators model the properties' sensitivity to temperature over a broad thermal range. The accuracy of estimation is adequate for most hydraulic engineering calculations. Many other physical properties can be expressed as functions of the six investigated, though the option remains to be added to this fundamental list. (Baker-IVI)
W84-04833

HIGH FREQUENCY EXCITATION AND VIBRATION STUDIES ON HYPERFILTRATION MEMBRANES,
California Univ., Berkeley. Water Thermal and Chemical Technology Center.
C. C. Herrmann.
Desalination, Vol. 42, No. 3, p 329-338, September, 1982. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *High frequency excitation, *High frequency vibration, *Hyperfiltration membranes, Water yield improvement, Reverse osmosis, Desalination, Desalination apparatus.

In an effort to increase the freshwater production rate, possible effects of high-frequency vibrations (both acoustically and electrically induced) on the hyperfiltration (reverse osmosis) process have been reexamined comprehensively. Cellulose-acetate membranes were used, both as customarily prepared by the Loeb-Sourirajan process, and with added magnetic and non-magnetic iron oxide powders. Flow and salt rejection were measured with sodium chloride feeds, without and with iron hydroxide or calcium sulfate membrane fouling. Flow rejection were substantially independent of the applied vibrations over the frequency and power ranges applied. The one exception was ultrasonic vibration on a depressurized, foul membrane, which showed an advantageous cleaning effect (hyperfiltrate flux increased after the treatment), confirming previous observations. (Author's abstract)
W84-04939

EXCHANGE PROCESSES AT THE SURFACE OF WATER (AUSTAUSCHVORGANGE AN DER OBERFLACHE VON GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 2K.
W84-05259

STUDY OF WATER,
University Coll., Dublin (Ireland). School of Engineering.
For primary bibliographic entry see Field 2A.
W84-05296

2. WATER CYCLE

2A. General

ADAPTIVE PARAMETER ESTIMATION FOR NON-LINEAR HYDROLOGICAL MODELS WITH GENERAL LOSS FUNCTIONS,
Institute of Hydrology, Wallingford (England).
D. M. Cooper.
Journal of Hydrology, Vol. 58, No. 1-2, p 39-45, August, 1982. 4 Fig, 5 Tab, 25 Ref.

Descriptors: *Hydrologic models, *Mathematical equations, Estimating, Algorithms, Non-linear models, Recursive procedures.

A simple algorithm for sequentially estimating the parameters of non-linear hydrological models is presented. The method used is related to the Kiefer-Wolfowitz stochastic approximation algorithm. The examples demonstrate that it is possible to find sequential procedures which can be used to estimate the parameters of quite general models, subject to certain constraints on the derivatives of the loss structure used and the choice of parameterization and starting values. In practice the procedures may be rather sensitive when these constraints are not satisfied. Even in such cases, the recursively computed estimates and the derivatives of the loss function can demonstrate where model inadequacy occurs, and how important particular parameters are. (Baker-IVI)
W84-04837

DISCRETIZATION OF THE CONTINUOUS LINEAR CASCADE BY MEANS OF STATE SPACE ANALYSIS,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
A. Szollosi-Nagy.
Journal of Hydrology, Vol. 58, No. 3/4, p 223-236, September, 1982. 18 Ref.

Descriptors: *Performance evaluation, *Continuous linear cascade models, *State space analysis, Hydrological forecasting, Nash cascade, State space modeling, State transition matrix, Model studies, Hydrologic aspects, Hydrologic data, Hydrologic models, Forecasting, Mathematical models, Mathematical equations.

Following the principles of state space analysis an attempt was made to derive a theoretically verified discretization of the continuous Nash cascade. In applying digital filtering techniques for hydrological forecasting by means of cascade models a discrete model of the continuous processes involved is necessary. The paper deals with the discretization of the continuous Nash cascade. The principles of state space modelling are used. The continuous state variable model of the Nash cascade together with the computation of the state transition matrix and the impulse response is given. A discrete state variable model is derived whose state and input transition matrices are in a dual relationship. Any different discrete state representations of the continuous Nash cascade are related to each other via a linear transformation. In the limit case the discrete state models are identical with the continuous Nash cascade. The discrete state models are discretely coincident with the continuous model but at the same time consider the dynamic changes in between the sampling points. A numerical example is presented. (Murphy-IVI)
W84-04848

HYDROLOGICAL CONDITIONS AND MEASURES OF WATER PROTECTION IN ENGADINE (HYDROLOGISCHE VERHALTNISSE UND GEWASSERSCHUTZMASSNAHMEN IM ENGADIN),
Amt fuer Gewasserschutz Graubunden, Chur (Switzerland).
R. Gartmann.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 172-180, 1982. 3 Tab.

Descriptors: *Drainage area, *Hydrologic aspects, *Hydrology, *Engadine, Flaz River, Spol River, Schergenbach River, Inn River, Water pollution control, Switzerland.

The drainage area of the Inn with its main affluents, namely Flaz, Spol and Schergenbach until Martinsbruck covers a total area of 1945 sq km; it is situated at an average altitude of 2350 m over the sea and a glacier covers about 5.4% of its surface. The Engadine and its side values have a population of somewhat more than 21,500 permanent inhabitants. Its main industries are tourism with more than 47,000 beds or 3.1 million booked nights per year and the production of about 1 billion kWh/p.a. of hydroelectric energy which corresponds to high peaks of drinking water, sewage and wastes resulting from the reduced run-off of the rivers because of the production of energy, as well as from special infrastructure problems of the communities. Owing to the waste water treatment plants already built, more than 80% of the sewage of the permanent population and of the tourists can be treated as required by the law and the total production of wastes can be treated without damage to the environment. (Author's abstract)
W84-04906

REGIONAL MONTHLY RAINFALL-RUNOFF MODEL,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou, and A. R. Rao.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 75-93, January, 1983. 17 Fig, 6 Tab, 8 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Flow, Nonlinear programming, Basins, River basins.

A simple regional model for basins with either linear or nonlinear monthly rainfall-runoff behavior is presented. The structure of the model depends on two key parameters: an order parameter and a memory parameter, which control the runoff behavior of the basin and the memory of the rainfall-runoff process, respectively. The order parameter, k, is a basin characteristic, whereas the memory parameter, n, is a characteristic of month, equal to k for months with delayed runoff and zero otherwise. For basins with linear monthly rainfall-runoff behavior, k is equal to one. For basins with nonlinear monthly rainfall-runoff behavior, k is greater than one and is equal to the approximate order of nonlinearity of the monthly rainfall-runoff functional relations. Good relationships exist between the coefficients of the model and the monthly runoff coefficients of the basin, and between the latter and the rainfall reduced to the unit area of the basin. Under such circumstances the model is regionalized and may thus be used in other ungaged basins of the same region. The model preserves the historical monthly means and standard deviations of flow at the 90% confidence level. (Baker-IVI)
W84-04957

DERIVATION OF DISCRETELY COINCIDENT FORMS OF CONTINUOUS LINEAR TIME-INVARIANT MODELS USING THE TRANSFER FUNCTION APPROACH,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
K. M. O'Connor.
Journal of Hydrology, Vol. 59, No. 1-2, p 1-48, October, 1982. 2 Fig, 1 Tab, 37 Ref.

Descriptors: *Model studies, *Hydrologic models, Flood routing, Stochastic hydrology, Mathematical models, Parametric hydrology.

A general transfer function (transform) method for deriving the discretely coincident forms (difference equations) of continuous linear parametric models (differential equations) is presented. Examples of the method, for zero-order (pulsed) and first-order (linear) input functions between the sampling intervals are given. The examples chosen are some of the classic continuous parametric models of linear deterministic hydrology. The method is capable of being extended to higher-order polynomial input

types. A comparison is made between the different forms of linear difference equations, commonly used in hydrology, namely: those based on finite-difference approximations to the classic continuous parametric models; discretely coincident forms of the classic continuous models; and discrete analogies of the classic continuous parametric models. (Baker-IVI)
W84-05126

DYESTUFF PENETRATION IN SOILS AT VEGETATION BOUNDARIES: THE EFFECT OF THE CANOPY,
Lancaster Univ., Bailrigg (England). Dept. of Geography.
P. J. Vincent, and J. V. Clarke.
Journal of Hydrology, Vol. 59, No. 1-2, p 149-160, October, 1982. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Interception, *Canopy, *Soil water, *Dye releases, Tracers, Vegetation, Soil surface, Precipitation, Alder, Oak, Pine, Spruce, Root channels, Seasonal variation.

Vegetation cover not only reduces the amount of rainfall that reaches the soil surface but also redistributes the intercepted rainfall, according to the type of vegetation present. On reaching the soil surface the downward movement of water is not uniform as it is dependent on a variety of factors such as hydraulic gradients and local porosity conditions. Water-insoluble 'disperse' dyestuff were used to investigate the penetration of precipitation into soil under various vegetation canopy conditions. Water-insoluble dyestuffs have advantageous properties; they are unlikely to be washed completely out of the soil after long periods, they are not biodegradable and are not attracted to the clay-humus complex. Experiments were carried out during a three-month spring and three-month autumn period at the Gisburn Forest, Yorkshire, England. Under open-canopy conditions, dyestuff penetration under a grass-health canopy and under deciduous alder and oak canopies was similar. Dyestuff penetration was reduced under the latter two canopies after leaf development. Dyestuff penetration under Scots pine and Sitka spruce during the same experimental periods did not show the same strong seasonal variation. Root channels may allow very effective movement of soil water. (Moore-IVI)
W84-05132

RAINFALL AND RECHARGE TO A DOLOMITE AQUIFER IN A SEMI-ARID CLIMATE AT KABWE, ZAMBIA,
Aspinwall Hydrotechnical Services Ltd., Shrewsbury (England).
J. F. T. Houston.
Journal of Hydrology, Vol. 59, No. 1-2, p 173-187, October, 1982. 10 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater recharge, *Rainfall, *Zambia, *Kabwe, Dolomite aquifers, Semiarid climates, Natural recharge, Recharge, Evapotranspiration, Forests.

The mean annual rainfall is 937 mm and over long periods of time appears to be relatively stable. Short-period fluctuations are marked and have considerable effect on recharge. Wet years tend to be more intense and of shorter persistence than dry years which by contrast tend to be less intense, less frequent and last slightly longer. The change from wet to dry years tends to show a cyclicity based upon periods of 8 and 4 years. The highest rainfall during the year occurs from December to March and at the same time evapotranspiration is relatively low. Thus recharge to groundwater storage can be expected to take place only during these months and this is confirmed by borehole hydrographs. The proposed recharge model differs slightly from the conventional methods and gives realistic results under semi-arid conditions, provided attention is paid to the natural vegetation cover and consequent estimates of evapotranspiration and selection of appropriate root constant. Precipitation recharge occurs every year over most of the outcrop and is estimated to be 281 mm on a mean annual basis but varies considerably with the annual rainfall. Under open-forest, recharge is restricted to high-rainfall years and the following year when soil-moisture deficits are still relatively low. Mean annual recharge under open forest is estimated to be 80 mm. (Baker-IVI)
W84-05134

TWO-D FLOW WITH SEDIMENT BY CHARACTERISTICS METHOD,
Colorado State Univ., Fort Collins.
P.-N. Lin, and H.-W. Shen.
Journal of Hydraulic Engineering, Vol. 110, No. 5, p 615-626, May, 1984. 3 Fig, 1 Tab, 9 Ref. NSF grant ENG7825054.

Descriptors: *Unsteady flow, *Mathematical equations, *Sediment transport, Suspended sediments, Sediment diffusion.

The theory of characteristics is applied to analyze two-dimensional unsteady flow over a bed of fine sediment. The case under consideration is that of flow over a bed of material which is so fine that suspension is the predominant mode of sediment transport, such as flow in some estuaries and in rivers carrying heavy loads of fine sediment. An additional equation for sediment diffusion is introduced so that five equations are available for five unknowns and characteristics are explicitly defined without resorting to complicated algebraic equations. An analysis by the theory of characteristics is desirable because it provides a means to determine the correct boundary conditions required in order to make the problems well posed. Results from a one-dimensional version of this procedure agreed reasonably well with known data. (Moore-IVI)
W84-05148

PRELIMINARY QUANTIFICATION OF THE IMPACTS OF ASPEN TO CONIFER SUCCESSION ON WATER YIELD - II. MODELING RESULTS,
Utah State Univ., Logan. Coll. of Natural Resources.
G. F. Gifford, W. Humphries, and R. A. Jaynes.
Water Resources Bulletin, Vol. 20, No. 2, p 181-186, April, 1984. 6 Fig, 1 Tab, 3 Ref. OWRT project B-175-Utah, OWRT grant 14-34-0002-9138.

Descriptors: *Water yield, *Succession, *Consumptive use, Aspen, Fir, Spruce, Model studies, Streamflow, Hydrologic models, Transpiration.

Due to lack of widespread disturbances by such things as natural fires and clearcutting, many areas once dominated by aspen have become coniferous forests. A hydrologic model of aspen to conifer succession has been modified to reflect data acquired from a part I of this study, concerning plant activity patterns and community crop coefficients for spruce, aspen, and fir forests. The model describing the hydrology of aspen to conifer succession (ASPCON) consists of a series of moisture storage compartments connected by transfer equations that systematically deal with each set of input data. Applying the new coefficients to describe the timing and rates of transpiration, the model predicts 18.6 cm net loss of moisture available for streamflow when spruce replace aspen, and a loss of 7.2 cm when fir forests replace aspen. The aspen to conifer successional trend appears, therefore, to be significantly reducing water yields in the western United States. (Moore-IVI)
W84-05156

STATUS OF RIPARIAN ECOSYSTEMS IN THE UNITED STATES,
New York State Dept. of Environmental Conservation, Delmar. Div. of Fish and Wildlife.
B. L. Swift.
Water Resources Bulletin, Vol. 20, No. 2, p 223-228, April, 1984. 3 Tab, 40 Ref.

Descriptors: *Ecosystems, *Riparian vegetation, Woody plants, Land use, Environmental effects, Water resources development, Urbanization, Floodplains.

An attempt was made to review all available data on the extent and status of riparian ecosystems in the U.S.A. This report presents a synthesis of the findings, including some estimates of how much land was originally covered by woody riparian vegetation, and how much remains in that condition today. A synopsis of information is presented on the status of riparian ecosystems in each of 10 regions: California, Pacific Northwest, Rocky Mountains, Arid Southwest, Plains-Grasslands, Lake States, Corn Belt, Mississippi Delta, Northeast-Appalachian, and Southeast. Woody riparian plant communities once covered an estimated 75 to 100 million acres of land in the contiguous 48 states. Mankind has converted at least two-thirds of that nationwide acreage to other non-forest land uses and it is estimated that only 25 to 35 million acres of riparian plant communities remain in a near natural condition. Across the country, loss of riparian acreages is directly attributable to water resource development (especially channel modification and water impoundment), floodplain clearing for agriculture, and urbanization. In many states of the arid west, the midwest, and the lower Mississippi alluvial valley, riparian vegetation has been reduced in area by more than 80 percent. Riparian woodlands are one of this country's most heavily modified natural vegetation types. (Author's abstract)
W84-05162

SEEPAGE FROM SURFACE WATERS (STROMUNGSVORGANGE IN NATURLICHEN SICKERKORPERN IN DER NAHE VON OBERFLACHENGEWASSERN),
Karlsruhe Univ. (Germany, F.R.).
V. Kaleris.
Wasserwirtschaft, Vol. 73, No. 11, p 464-468, November, 1983. 5 Fig, 1 Tab, 8 Ref.

Descriptors: *Infiltration, *Surface flow, Infiltration rate, Infiltration coefficient, Infiltration capacity, Hydrologic models, Performance evaluation.

There are apparent uncertainties in determining the infiltration rate of small streams by numerical models. These uncertainties are emphasized with decreasing infiltration rates. The higher the infiltration rate the less effects these uncertainties have on the models' outcome. With improved procedures and more accurate measurements the models' outcome could average out the effects of the uncertainties. The results are compared with those of direct measurements of the infiltration rate. (Murphy-IVI)
W84-05264

SENSITIVITY OF WATER RESOURCE SYSTEMS TO CLIMATE VARIATION,
World Meteorological Organization, Geneva (Switzerland).
J. Nemec, and J. Schaake.
Hydrological Sciences Journal, Vol. 27, No. 3, p 327-343, September, 1982. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Climatology, *Water resources, *Planning, Rainfall-runoff relationships, Streamflow, Hydrologic models, Climates, Arid climates, Humid climates, Climatic data.

One of the single most serious technical problems facing water resource managers is that of determining the appropriate response to climate change. Climate statistics are inherent in the design of water resource systems by the prediction of two aspects of hydrological processes. This includes the extremes and the averages. The importance of the sensitivity of the systems to such variations is demonstrated with respect to the stationarity of the mean and the extremes. A definition of moderate climate variation is adopted. Results of deterministic modelling of the influence of such a variation on streamflow are reported, in extreme conditions of arid and humid basins. The results are used in modelling the influence of climate variations on reservoir storage systems. The model indicates a considerable amplification of the effect of climate change on runoff and storage and emphasizes the importance of studies of sensitivity of water resource systems to climate variation. (Murphy-IVI)
W84-05290

STUDY OF WATER,
University Coll., Dublin (Ireland). School of Engineering.
J. C. I. Dooge.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 23-48, 1983. 3 Fig, 3 Tab, 53 Ref.

Descriptors: *Hydrology, *Reviews, *Physical properties, Fluid mechanics, Social aspects, Mathematical equations, Newtonian fluid, Molecular structure.

A number of questions relative to the background of hydrology are discussed. Specific consideration is given to the meaning of the term water in a scientific context, the purpose of water on the planet, the reason why most of the water here is found in liquid form, the physical properties of water, the molecular structure of liquid water, treatment of liquid water as a continuum, the possibility of water being a Newtonian fluid, the movement of a Newtonian fluid, equations of water movement commonly used in hydrology, possible usefulness of the Navier-Stokes equations in hydrology, and the reconciliation of the various approaches to the study of water movement to each other, including the view of water by the scientist, the biologist and the social scientist. (Baker-IVI)
W84-05296

ANTECEDENT MOISTURE CONDITION PROBABILITIES FOR SELECTED INDIANA STATIONS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
C. R. Burke, and D. D. Gray.
Proceedings of the Indiana Academy of Sciences, Vol. 92, p 219-226, 1982. 2 Fig, 2 Tab, 18 Ref.

Descriptors: *Probability distribution, *Moisture, *Weather forecasting, Indiana, Mathematical equations, Predicting.

The analysis of 258 years of daily weather observations at 10 Indiana stations has been used to provide reliable estimates of the probability of occurrence of the Antecedent Moisture Condition classes of the Soil Conservation Service Curve Number method and the Illinois Urban Drainage Area Simulator (ILLUDAS) computer program. The uniformity of the probabilities across the state means that probabilities for any location in Indiana can be interpolated with confidence. The present results confirm and supercede the less statistically significant Antecedent Moisture Condition (AMC) probabilities published previously for fewer Indiana stations. (Baker-IVI)
W84-05308

EFFECT OF RAINDROP IMPACT AND SLOPE LENGTH ON SEDIMENT CONCENTRATION OF RUNOFF,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2J.
W84-05311

FINITE-ELEMENT THREE-DIMENSIONAL GROUNDWATER (FE3DGW) MODEL FOR A MULTIAQUIFER SYSTEM,
Battelle Project Management Div., Columbus, OH.
S. K. Gupta, R. C. Cole, and G. F. Pinder.
Water Resources Research, Vol. 20, No. 5, p 553-563, May, 1984. 14 Fig, 13 Ref. DOE Y-76-C-06-1830, EPA grant P002103-01-0, DOE DE-AC02-83CH10140.

Descriptors: *Aquifer characteristics, *Hydrologic models, Finite element method, Mathematical studies, Model studies, Groundwater, Computers, Aquifers.

Using a three-dimensional, isoparametric, finite-element scheme, a computer model (FE3DGW) is developed to simulate the steady state and transient behavior of large, natural, multilayered groundwater systems. A hydrologic basis for developing a finite-element grid is presented. Graphical displays generated by the supportive programs of the model and used to verify the input data of large, natural groundwater systems and to facilitate the interaction between modeler and field hydrogeologist are also given. Core storage was reduced by the three following methods. Small, independent subprograms were used, and only the parameter required by the subprogram was brought in core. Core storage was provided for one element only. The rest were stored on disk for sequential retrieval. In simulation of large, natural aquifer systems, unbanded sparse matrices of equations occur, requiring high core storage. Two matrices, one for storing only nonzero coefficients and one for the column identification of these nonzero coefficients were used. Ways in which the cost of three-dimensional computation was reduced are discussed. Model applications are illustrated with the simulation of a groundwater reservoir beneath Long Island, New York. The finite-element solutions are compared with electric analog models of the same region. (Baker-IVI)
W84-05329

DAILY PRECIPITATION MODELING BY DISCRETE AUTOREGRESSIVE MOVING AVERAGE PROCESSES,
Ohio Univ., Athens. Dept. of Civil Engineering.
T. J. Chang, M. L. Kavvas, and J. W. Delleur.
Water Resources Research, Vol. 20, No. 5, p 565-580, May, 1984. 13 Fig, 4 Tab, 27 Ref. USDI grant OWRT-B-112-IND.

Descriptors: *Precipitation, *Model studies, DARMA, Markov process, Mathematical studies, Stochastic process, Indiana.

Various models from the discrete autoregressive moving average (DARMA) family are constructed for and applied to the daily precipitation data in Indiana to account for the statistical dependence among the daily precipitation magnitudes and among the daily precipitation occurrence times. The structure of the DARMA family is specified by the marginal distribution of independent identically distributed (i.i.d.) discrete random variables and by their random linear combination. The fact that the correlation structure of the DARMA family can be specified independently of its marginal density is one fundamental property of the family. The DARMA correlation structure remains invariant under transformation of the marginal density. The Indiana daily precipitation data satisfied this property and facilitated their modeling by the DARMA family of processes. The Markov chain is a specified model with DARMA family. By discretizing the daily precipitation amount into a number of magnitude states the Indiana daily precipitation data was transformed into a multistate discrete precipitation sequence. The stochastic process of the daily precipitation sequences is analyzed in terms of the locally stationary seasons defined within the paper. In each season the candidate DARMA models are identified in terms of the covariance function within the season. The parameter estimation of these candidate models is done by fitting their theoretical autocorrelation functions to their empirical counterparts, and the state probabilities are obtained through the multistate mean run lengths. The theoretical run length distributions of the candidate models are derived for each of the precipitation magnitude states, including the dry state. The goodness-of-fit tests of the candidate models and the best model selection are based on the theoretical multistate run length distribution of the daily precipitation data. (Baker-IVI)
W84-05330

QUANTITATIVE ANALYSIS OF EXISTING CONDITIONS AND PRODUCTION STRATEGIES FOR THE BACA GEOTHERMAL SYSTEM, NEW MEXICO,
Geotrans, Inc., Herndon, VA.
W. P. Balleau.
Water Resources Research, Vol. 20, No. 5, p 601-618, May, 1984. 15 Fig, 6 Tab, 37 Ref. Bureau of Indian Affairs contract MOOC14203411.

Descriptors: *Geothermal studies, *Model studies, Jemez River, Jemez Spring, Baca, New Mexico, Jemez Mountains, Fluid mechanics, Flow, Finite difference methods.

This modeling study is an attempt to bring together existing information and data on the Baca location and to develop a rational framework on how the system operates. The framework is a numerical model that incorporates a conceptual description of the physics of fluid flow and heat transport in an equivalent porous medium, the thermodynamics of two phase, single component water, a geometric description of the Baca field including boundary conditions, and the hydrologic and heat transport parameters that characterize the Baca field. The geothermal reservoir is recharged from a deep source having a small effective area. Vertical permeabilities are less than horizontal permeabilities in the geothermal reservoir. The calibrated preproduction thermal water discharge determined by numerical simulation is about 51,000 g/s (1310 acre feet/year), with about 88% of that discharge occurring at or above the Jemez Springs area. The contribution to base flow in the Jemez River is primarily from shallow groundwater aquifers. The total base flow along the Jemez River estimated for preproduction conditions is about 539,000 g/s (13,800 acre feet/year), which is about 10 times larger than the thermal water contribution. For a 30-year production period the following changes in reservoir conditions are estimated: a maximum reservoir pressure decline of 750 psi will occur in the main production zone in the lower part of the reservoir, the maximum steam saturation within the reservoir in the main production area will be about 40%, and maximum temperature declines in the production zone will be less than 3 degrees C. (Baker-IVI)
W84-05333

EFFECTS OF SPATIAL VARIABILITY OF HYDRAULIC RESISTANCE OF RUNOFF HYDROGRAPHS,
Colorado Agricultural Experiment Station, Fort Collins.
Y.-H. Wu, D. A. Woolhiser, and V. Yevjevich.
Journal of Hydrology, Vol. 59, No. 3-4, p 231-248, November, 1982. 10 Fig, 4 Tab, 9 Ref.

Descriptors: *Overland flow, *Runoff, Hydrographs, Roughness, Watersheds, Rainfall, Rainfall-runoff relationships, Spatial distribution.

The effects of spatial variability of roughness on runoff hydrographs have been investigated for an experimental watershed facility surfaced with butyl rubber or various combinations of butyl rubber covered with gravel. An equivalent uniform roughness (defined in terms of the hydrograph response to identical rainfall excess patterns) can be used for a watershed with nonuniform roughness over its surface, if the hydrographs from this watershed are equivalent to the hydrographs of a watershed of equivalent uniform roughness for identical rainfall excess patterns. The factors that affect the application of the equivalent uniform roughness concept are the differences between roughnesses, relative subarea of a given constant roughness, and the size of these uniform roughness subareas. For a watershed composed of alternate strips of equal widths of two roughness surfaces along the flow direction, apparently the watershed can be approximated by an equivalent uniform roughness surface, if the width of strips is less than or equal to one-sixth of the total flow length. The lumped parameters of the two-parameter model for a watershed of equivalent uniform roughness can be estimated by selecting those parameter values which reproduce the equilibrium detention storage on the nonuniform surface and are consistent with the values for the individual roughness elements. These conclusions are strictly valid only for overland flow on conical section watersheds, with two kinds of roughness elements. Only surface runoff response was considered. (Baker-IVI)
W84-05339

SPACE-TIME QUANTIFICATION OF RAINFALL INPUTS FOR HYDROLOGICAL TRANSPORT MODELS,
Agricultural Research Service, Chickasha, OK. Southern Great Plains Watershed Research Center.
A. D. Nicks.

Journal of Hydrology, Vol. 59, No. 3-4, p 249-260, November, 1982. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Hydrologic models, *Rainfall, Spatial distribution, Temporal distribution, Model studies, Transport.

Time and spatial rainfall input to hydrological models are discussed from the standpoint of available data sources, microscale and mesoscale networks and the type of models available. Using rainfall records from a dense network of recording raingages methods of distribution rainfall from point amounts to distributed runoff model area elements are tested. Density of the raingage network spacing vs. size of the distributive model elements are tested on basins ranging in size from 67 to 2926 sq km. Models should be developed that will account for time increment effects on runoff generation. One model tested showed an increase of 24% in predicted runoff when breakpoint rainfall was input instead of the original hourly input data. Spatial distribution of rainfall described by experimental watershed networks is probably adequate for most distributive type models. For the wide spaced climatological networks, the costs of using available distribution methods would be prohibitive for short time input with a small grid interval on a large area. More research is needed to set guidelines on the size of grid element vs. network gage density. (Baker-IVI)
W84-05340

GENERALISED ONE-DIMENSIONAL KINEMATIC CATCHMENT MODEL,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
W. G. Field, and B. J. Williams.
Journal of Hydrology, Vol. 60, No. 1-4, p 25-42, January, 1983. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Kinematic wave theory, *Catchments, Mathematical studies, Model studies, Hydrologic models.

A numerical model has been developed for the solution of the kinematic wave equation for a one-dimensional catchment whose physical characteristics are continuously variable along the length of the mainstream, using the Lax-Wendroff technique. The model has been verified by comparing its solutions with some analytical solutions already available. Certain catchment parameters have been identified, some effects of storage non-linearity are noted, and the model is appplied with promising results to two actual catchments to ascertain their values. The two most restrictive limitations of the model are the one-dimensional assumption of uniform flow across the width of the catchment, and the assumption of spatially uniform rainfall over the catchment. (Baker-IVI)
W84-05347

2B. Precipitation

SPATIAL AND TEMPORAL RELATIONSHIPS BETWEEN THE INDIAN SUMMER MONSOON RAINFALL AND THE SOUTHERN OSCILLATION,
Indian Inst. of Tropical Meteorology, Poona.
B. Parthasarathy, and G. B. Pant.
Tellus, Vol. 36A, No. 3, p 269-277, May, 1984. 5 Fig, 2 Tab, 30 Ref.

Descriptors: *Spatial relationships, *Temporal relationships, *Indian summer monsoon, *Rainfall, *Southern oscillation, Tropical circulation, Monsoons, Air circulation, Air masses.

The Southern Oscillation is one of the important tropical circulation features having a profound influence on the Indian summer monsoon. A detailed investigation of the association between the Southern Oscillation Index (SOI) series of Wright and the Indian summer monsoon rainfall for a period of 104 years (1871-1974) has been carried out. The correlation analysis was carried out for two seasons (MAM and JJA) of SOI and June to September area-weighted rainfall series of India, its 29 subdivisions, and 306 individual representative stations. The series has been examined by dividing it into two equal halves of 52 years, and different sliding window width series of 10, 20 and 30 years. The correlations for the concurrent season (SOI-JJA) show a stable and highly significant relationship, whereas the correlations of the previous season (SOI-MAM) with summer monsoon rainfall are marginally significant for few areas of the country. The space and time relationships between the Southern Oscillation and Indian summer monsoon rainfall have potential applications for the understanding and prediction of the large-scale performance of the monsoon. (Author's abstract)
W84-04808

RADAR RAIN FORECASTING FOR WASTEWATER CONTROL,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Agricultural Engineering.
C. Damant, G. L. Austin, A. Bellon, M. Osseyrane, and N. Nguyen.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 293-297, February, 1983. 16 Ref.

Descriptors: *Weather forecasting, *Rainfall, *Radar, *Combined wastewater, *Montreal, *Quebec, Forecasting, Flushing, Storms, Error analysis, Wastewater management.

A statistical analysis of the errors involved in forecasting rain amounts for the Island of Montreal using weather radar data has been undertaken. The wastewaters of all municipalities of the Communaute Urbaine de Montreal (CUM) at present discharged into the Riviere des Prairies, will be collected by a new north interceptor and conveyed to a treatment plant at the east end of the island. This interceptor was designed to collect all the flow from the sanitary sewers. However, it will only carry 2.5 times the mean dry weather flow from the combined sewage and stormwater drains. The amounts of rain accumulated in 1 hr over the CUM gages is measured by the low resolution radar data to an accuracy of 33%. Moreover, this same resolution data has been demonstrated to give forecast accumulation to an accuracy of within 68%, 89%, and 102%, for 1-, 2-, and 3-hr forecasts. It is thought that these errors could be significantly reduced if the new data were reanalyzed at higher resolution. It remains to be seen if forecasts of this accuracy are useful in giving a significant improvement in the operation of the CUM wastewater management system compared with the present situation of no or vague forecast information. (Baker-IVI)
W84-04832

PROBABLE RAINFALL ESTIMATES AND THE PROBLEMS OF OUTLIERS,
Iwate Univ., Morioka. Faculty of Agriculture.
N. Kishihara, and S. Gregory.
Journal of Hydrology, Vol. 58, No. 3/4, p 341-356, September, 1982. 7 Fig, 5 Tab, 14 Ref.

Descriptors: *Rainfall, *Forecasting, *Rainstorms, Prediction, Daily rainfall, Depth-area-duration analysis.

The occurrence of the unusual 'Exceptionally heavy' short period rainfall event is characteristic of virtually all areas of the world, and these occurences have important implications for floods and landslides, dam construction, river works, and soil- and water-conservation structures. The problem of estimating return periods of maximum daily rainfall when one or two extreme events are exceptionally large has been examined, but not resolved, by many writers. The present paper attempts to specify and clarify these conditions, preparatory to proposing solutions in a later paper. Earlier work on this problem in Japan, the U.S.A. and the U.K., is reviewed, and 90 stations in the U.K. are classified into several 'return period types' following the method proposed by Kikuchibara for Japan. The effectiveness with which the 100-yr. return period value can be estimated by a large number of standard methods is examined for each of these different 'types', and the inadequacy of all of them in relation to the exceptional extreme event is stressed. It is evident that stations often change from one of these 'types' to another, and that therefore the ability to estimate the 100-yr. return period valu also changes markedly with time. (Murphy-IVI
W84-04855

MOON INFLUENCES WESTERN U.S DROUGHT,
R. A. Kerr.
Science, Vol. 224, No. 4649, p 587, 11 May, 1984. Ref.

Descriptors: *Drought, *Tidal effects, *Luna cycle, *Great plains, Tidal cycle, Climates, Tida cycle, Moon, Tree rings.

Although it is a subtle effect, the lunar cycle tha influences drought in the American Great Plains in combination with a previously reported sola influence, may on rare occasions wreak such widespread havoc as the Dust Bowl of the 1930's. The narrowing of tree rings during drought conditions revealed a tendency over a 360 yr record toward an expansion of the area of drought about every 2 years. Further studies linked the tree rings theory more closely with the 18.6 yr cycle of the moon's changing declination, during which its maximum height in the sky varies by 20 of its diameters, rather than to the 11 year sunspot cycle. The effect of the moon on the Great Plains must act through gravity-induced tides. The 18.6 year cycle of the moon's declination elicits varying tides in the atmosphere just as the apparent daily motions of the moon raise tides in the atmosphere and the ocean. How the relatively weak variations of the 18.6 year cycle gain the leverage to influence the vigorous motions of the atmosphere is not clear. (Baker-IVI)
W84-04879

AUTOMATIC MAPPING OF RAINFALL DATA: STUDY OF RAINFALL - MORPHOMETRIC RELATIONSHIPS (CARTOGRAPHIE AUTOMATIQUE DES CARACTERISTIQUES PLUVIOMETRIQUES: PRISE EN COMPTE DES RELATIONS PLUVIOMETRIE - MORPHOMETRIE),
Ecole Nationale Superieure de Geologie Appliquee et de Prospection Miniere, Nancy (France).
J. P. Laborde.
La Houille Blanche, Vol. 4, p 331-338, 1982. 12 Fig, 2 Tab, 15 Ref.

Descriptors: *Automatic mapping, *Rainfall data, *Rainfall, *Rainfall distribution, Rainfall gages, Rainfall area, Rainfall index, Rainfall rate, Depth-area-duration analysis, Performance evaluation, Data acquisition, Meteorological data collection, Terrain analysis, Topography.

An automatic method for mapping rainfall parameters allows both the observations recorded in rainfall stations and the topographical factors influencing the distribution of rain to be taken into account. It is proposed that the characteristics of a site can be determined as its altitude and the depth between hills (the latter being measured by the average tangent of the angle at which the horizon is seen). It appears that the sampling of altitudes at the nodes of a square 2.5 by 2.5 km meshed network allows the topographical elements playing a leading role on rain distribution to be determined. The details of the tracing can be voluntarily limited as required for the desired specificity in the estimates of the rainfall parameters to be mapped. (Murphy-IVI)
W84-04948

AREAL RAINFALL VARIABILITY AND THE DESIGN OF A RAINFALL MONITORING NETWORK FOR SHARK RIVER SLOUGH, EVERGLADES NATIONAL PARK, FLORIDA,
Everglades National Park, Homestead, FL. South Florida Research Center.
R. M. Lew, M. D. Flora, and P. C. Rosendahl.
Florida Scientist, Vol. 47, No. 1, p 55-62, Winter, 1984. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Rainfall distribution, *Monitoring, *Forecasting, *Florida, *Shark River Slough, Everglades National Park, Networks, Rain gages.

Biweekly rainfall was measured from an 87 station rainfall monitoring networks located in Shark River Slough for 22 mo beginning in December of 1977. Cumulative rainfall for the period was 201.7 cm and ranged from 150 cm in northeastern Shark Slough to more than 230 cm in southern Shark Slough. The 87 gauge network had a mean density of 11.4 sq km/gauge and a density range of 1.04 sq km/gauge to 69.6 sq km/gauge, allowing for the detection of 90% of all showers when mean area rainfall was between 0.025 cm and 0.13 cm; and 570 sq km/gauge, allowing for detection of all rain days when mean area rainfall was greater than 1.3 cm. Based upon the areal variability of precipitation patterns, gauge density and design criteria evaluated in this study, a long-term rainfall monitoring network consiting of 8 permanent stations has been developed for the Shark River Slough. this network is symmetrically spaced and consists of standard Weather Service 61 cm gauges. (Baker-IVI)
W84-05012

STUDY OF SPACE VARIATIONS OF PRECIPITATION BY FACTOR ANALYSIS,
Ecole Polytechnique, Montreal (Quebec).
P. Beaudoin, and J. Rousselle.
Journal of Hydrology, Vol. 59, No. 1-2, p 123-138, October, 1982. 4 Fig, 4 Tab, 11 Ref. Ministere de l'Education du Quebec grant CRP-356-75.

Descriptors: *Precipitation, *Spatial distribution, *Factor analysis, *Montreal, *Quebec, Rainfall distribution, Seasonal variation.

Spatial variations in daily precipitation in the region of Montreal, Quebec are examined through factor analysis of the inter-station correlation coefficients matrices. A sample of 25 years of daily precipitation data, which were available at 19 stations, was selected for the study. Independent analyses are made for each of the four seasons of the year. Factor patterns are obtained from oblique rotation of the first six principal components of the correlation matrices. Areas in which meteorological stations have a similar factor pattern are delimited. The clustering was not very different from season to season, although the variance explained by six factors was less in summer than in the other seasons, due to the higher variability of precipitation in summer. In the Montreal region, clusters were generally formed in the Laurentians, at the foot of the Appalachian Mountains, at Montreal Island and the adjacent south shore area, and in the plains north of Montreal Island; also two clusters were formed in the south of the region which were different in shape from season to season. The whole area could be divided into only five areas having relatively homogeneous climatological characteristics. Extreme values in the data have a strong weight in the computation of the factor patterns. However, in the Montreal region, the regionalization obtained from analyses of samples containing only small values of precipitation has the same general shape as the one obtained from samples of large values. Factor analysis represents an objective way of condensing information in a meteorological network, but it must be subjected to the investigator's judgement. (Moore-IVI)
W84-05130

DERIVING RAINFALL INTENSITY-DURATION-FREQUENCY RELATIONSHIPS AND ESTIMATES FOR REGIONS WITH INADEQUATE DATA,
Lagos Univ. (Nigeria). Dept. of Geography.
L. Oyebande.
Hydrological Sciences Journal, Vol. 27, No. 3, p 353-367, September, 1982. 2 Fig, 8 Tab, 14 Ref.

Descriptors: *Nigeria, *Rainfall intensity, *Intensity-duration-frequency relationships, Regional analysis, Spatial distribution.

In order to overcome the two-fold problem of inadequate rainfall record length and coverage for Nigeria, regional analysis is used in which data for individual stations are lumped together or compounded to yield larger regional data samples. Type 1 extreme-value distribution (Gumbel) was applied to the annual extreme rainfall data sets generated by 11 rainfall zones to estimate the parameters and hence the intensity-duration-frequency (IDF) rainfall. The chi-square test confirmed the appropriateness of the fitted distribution. Gumbel graphical plots and the computed confidence limits also showed that the Gumbel EV-1 function fits well the empirical distribution. The results obtained should serve to meet the need for rainfall IDF relationships and estimates in various parts of Nigeria, both for short and long recurrence intervals. The need has been particularly great because many large basins remain inadequately gauged while some are hardly gauged at all. (Moore-IVI)
W84-05292

DISTRIBUTION OF CATCHMENT COVERAGE BY STATIONARY RAINSTORMS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
P. S. Eagleson.
Water Resources Research, Vol. 20, No. 5, p 581-590, May, 1984. 8 Fig, 3 Tab, 26 Ref. National Science Foundation grant ATM-8114723.

Descriptors: *Catchment areas, *Storms, *Model studies, Poisson distribution, Mathematical equations, Tropical regions, Thunderstorms, Sudan, Precipitation.

The fraction of a catchment's area wetted by a rainstorm occurrence within the catchment is modeled by the sum of independent random cell clusters whose stationary centers are Poisson-distributed in space and whose areas are fractals having identical (hyperbolic) pdfs. The cell clusters collected within the catchment are called catchment storms. They have specific areas and are assumed to be Poisson distributed in time. The independence, stationarity, and areal homogeneity assumptions associated with the cell clusters are met most closely by tropical air mass thunderstorms. The mean and variance of catchment average annual precipitation are derived in terms of the catchment area, the fractal dimension, the minimum cell cluster area, the maximum cell cluster area, and the two Poisson parameters. Station precipitation data from Sudan are used to evaluate the Poisson parameters. The average number of cell clusters per storm is large so that for large catchments, at least, the central limit theorem can be invoked and the entire distribution of storm area is approximated with these two moments. It should be possible to extend this work to eliminate some of the restrictive independence assumptions by introducing appropriate correlation structures and to include other storm types, both stationary and travelling. (Baker-IVI)
W84-05331

2C. Snow, Ice, and Frost

GLOBAL THERMODYNAMICS OF A POLAR ICE SHEET,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
C. J. Van Der Veen, and J. Oerlemans.
Tellus, Vol. 36A, No. 3, p 228-235, May, 1984. 7 Fig, 1 Tab, 13 Ref.

Descriptors: *Thermodynamics, *Polar ice sheets, Ice-water interfaces, Ice, Ice breakup, Snowmelt, Melting, Temperature effects, Drainage systems, Model studies, Flow characteristics, Antarctic.

In ice-sheet dynamics, the interaction between ice flow and temperature plays an important role. A simple approach to study the total heat budget of a drainage system is presented by investigating the global characteristics of a polar ice sheet. When looking at a drainage system as a whole, conservation of heat yields a very simple functional relation. Coupling this relation to an equation describing the large-scale dynamics of a drainage system makes it possible to study the feedback of thermodynamics on the ice-mass discharge. It is found that the temperature-ice flow feedback (including the effect of basal meltwater) can give rise to bifurcation. For certain combinations of air temperature and mass balance, two stable flow regimens are possible for a polar ice sheet: fast flow, with high basal temperatures and slow flow, with low basal temperatures. Basal melting is strongly reduced when the accumulation rate increases. Thus a polar drainage system can be brought into the fast flow regime (with meltwater present) by reducing the mass balance, or by increasing the air temperature. The calculation of the global heat budget is also applied to flow lines of the antarctic ice sheet. The flow line into the Ross Sea has at present a large imbalance. It seems that the ice sheet is cooling, and consequently, building up. (Murphy-IVI)
W84-04807

SNOW-COVER AREA VS. SNOWMELT RUNOFF RELATION AND ITS DEPENDENCE ON GEOMORPHOLOGY - A STUDY FROM THE BEAS CATCHMENT (HIMALAYAS, INDIA),
Roorkee Univ. (India). Dept. of Earth Sciences.
R. P. Gupta, A. J. Duggal, S. N. Rao, G. Sankar, and B. B. S. Singhal.
Journal of Hydrology, Vol. 58, No. 3/4, p 325-339, September, 1982. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Snow cover, *Snowmelt, *Snowmelt-runoff relationships, *Geomorphology, *Beas catchment, *Himalayas, *India, Runoff volume, Remote sensing, Satellite technology, Discharge hydrographs, Mapping.

Snowmelt forms a considerable proportion of the total runoff in many streams. Modern remote-sensing techniques using satellite platforms offer a promise for monitoring the snow cover area. The River Beas, in the northwestern part of India, was chosen to study the relation between snow-cover area and snowmelt runoff. Snow cover area was mapped from the LANDSAT images for a number of years in various subcatchments. The river discharge, excess over the baseflow, in days of non-concurrent rain-precipitation, was computed which could be attributed to snowmelt alone. The snow cover area and the subsequent snowmelt runoff in various subcatchments are found to be well correlated. It is interpreted that there have been years of uniformly heavier and lighter snowfall all over the basin and the snowmelt discharges have consequently systematically varied. For a particular subcatchment, the relationship between snow-cover area and snowmelt runoff seems to be independent of geographic factors like solar illumination, catchment orientation and relative location. On the other hand, it appears to depend on geomorphical factors such as size of the subcatchment, permanent snowcover area, average altitude, lithology and stream order. Hence, for each type of geomorphical subcatchment, a different empirical relation should exist between snowcover area and snowmelt runoff. (Murphy-IVI)
W84-04854

ICE COVER AND HYPOLIMNETIC REOXYGENATION IN THE GREIFENSEE FROM 1950 TO 1980 (EISBEDECKUNG UND HYPOLIMNISCHE SAUERSTOFFANREICHERUNG IM GREIFENSEE VON 1950 BIS 1980),
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
For primary bibliographic entry see Field 2H.
W84-04905

GREAT LAKES ICE DYNAMICS SIMULATION,
State Univ. of New York at Buffalo. Dept. of Civil Engineering.
A. Wake, and R. R. Rumer, Jr.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 1, February, 1983. 9 Fig, 30 Ref.

Descriptors: *Ice dynamics, *Model studies, *Great Lakes, Lakes, Thermodynamics, Ice fields, Water stress, Wind, Ice transport, Ice deformation, Simulation, Mathematical models.

A previously developed thermodynamic model for ice formation, growth, and dissipation has been

extended to account for ice transport and deformation due to wind and water stress. This ice dynamics simulation model has been designed for application to the Great Lakes to aid in forecasting ice conditions during winter navigation. By viewing the fragmented ice field conceptually as a continuum, the governing ice mass transport equations have been formulated for the Great Lakes. In the continuum representation, the internal ice stresses and ice movement are related by a constitutive law. In this study, a viscous-type constitutive law has been adopted for representing the internal stress for lake ice. The degree to which the prototype lake-ice condition is approximated by the viscous analogy is a subject for continued study. Calibration of the model application to Lake Erie will be accomplished through the use of SLAR data and ice information provided by the U.S. Coast Guard. In addition to the adjustment of the coefficients in the constitutive law, several other uncertainties remain to be resolved, including the extent to which the continuum assumption can be employed in the study of lake-ice dynamics. The developed ice dynamics simulation model may be applied to selected portions of one of the Great Lakes as well as to an entire lake. This model may be useful in estimating the time for ice dissipation where ice transport and ice melt are both important to the rate of ice disappearance. (Baker-IVI)
W84-04962

SNOW AND ICE IN A CHANGING HYDROLOGICAL WORLD,
Geological Survey, Tacoma, WA.
M. F. Meier.
Hydrobiological Sciences Journal, Vol. 28, No. 1, 3, 1983. 5 Fig, 4 Tab, 91 Ref.

Descriptors: *Hydrologic budget, *Ice cover, *Snow, Glaciers, Hydrologic cycle, Climatology, Heat flow, Solar radiation.

The world's water balance is reviewed with special emphasis on the role of snow and ice in the global hydrological climatic system. Snow cover on land (especially in the Northern Hemisphere) and sea ice (especially in the Southern Hemisphere) vary seasonally, and this seasonal change has an important effect on the world climate as snow and sea ice reflect solar radiation efficiently and affect other heat flow processes between atmosphere and land or ocean. Glaciers, including ice sheets, store most of the fresh water on Earth, but change dimensions relatively slowly. Glacier ice volume may be currently declining, but there is no clear evidence to that point. The current rise in sea level is difficult to explain. Thermal expansion of the oceans may account for half of the present rise, but the other half is uninterpreted. While major changes in the large ice sheets take place over time scales of 10,000 to 100,000 years, marine ice sheets may be subject to rapid disintegration due to grounding line instability, perhaps accompanied by surging. Ice cores may produce remarkably complete histories of air temperature, precipitation, fallout, and atmospheric composition. (Baker-IVI)
W84-05295

2D. Evaporation and Transpiration

INDIRECT MEASUREMENT OF THE LATENT HEAT FLUX OF MEADOW GRASS FROM THE ENERGY BALANCE - THE SENSIBLE HEAT FLUX BEING MEASURED BY USING THE CORRELATION TECHNIQUE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Physics and Meteorology.
A. F. G. Jacobs, and C. L. Palland.
Journal of Hydrology, Vol. 58, No. 1-2, p 159-166, August, 1982. 5 Fig, 13 Ref.

Descriptors: *Heat flow, *Grasses, *Evaporation rate, Meadows, Schoonheete, Netherlands, Radiation, Soil water, Temperature effects.

Evaporation from natural surfaces may be estimated by measuring the most important energy terms near the surface. Direct measurements of net radiation, soil heat and sensible heat fluxes are continuously taken over a grass surface at Schoonheete, The Netherlands. The data are integrated over 1 hr intervals and the sensible heat is measured by using an eddy correlation technique. The results show no phase lag between sensible heat and radiation densities and a phase lag of about one hour between sensible heat and latent heat densities. An explanation for this time lag is the effect ascribed to the later peak of the vapor pressure deficit. A comparison is given between the real evaporation and the potential one. In cases described in the literature during the first hours of a day, the actual evaporation of grass equals the potential evaporation. But in the late morning a so-called depression takes place. Two reasons why this did not occur during the selected study period are: the temperature during this period was rather warm for a summer situation and, more importantly, the amount of precipitation during the preceding period had amply supplied the grass with moisture. (Baker-IVI)
W84-04845

EVAPORATION FROM VEGETATION IN LANDSCAPES DEVELOPING SECONDARY SALINITY USING THE VENTILATED-CHAMBER TECHNIQUE, IV. EVAPORATION FROM A REGENERATING FOREST OF EUCALYPTUS WANDOO ON LAND FORMERLY CLEARED FOR AGRICULTURE,
Commonwealth Scientific and Industrial Research Organization, Floreat Park (Australia). Div. of Land Resources Management.
E. A. N. Greenwood, J. D. Beresford, J. R. Bartle, and R. J. W. Barron.
Journal of Hydrology, Vol. 58, No. 3/4, p 357-366, September, 1982. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Evaporation, *Vegetation, *Salinity, *Ventilated-chamber, *Regenerating forest, *Eucalyptus wandoo, Leaves, Saline water intrusion, Trees, Evaporation area, Evaporation discharge, Aeration zone.

Daily evaporation from five regenerating trees, ranging in leaf area from 1-70 sq m, and from areas of pasture near them, was periodically measured over a year. The aim was to obtain indirect evidence of the ability of regenerating trees to take up a significant quantity of water from a phreatic aquifer which was causing secondary salinity downslope. In the spring and early summer daily evaporation rates varied greatly between sampling occasions, the main influences being the physical nature of the day, the timing of the yearly flush of leaf growth and intense attacks of leaf-eating insects. From mid summer to late autumn, evaporation was low at all times, implying that the supply of soil water was limiting. This view is supported by concurrently low values of soil water content and by the failure of excavation to reveal a deep root system. A close relationship (sq R = 0.99) was found between the average value of evaporation over the year for each tree (y) and its plan area (x) on an aerial photograph. The relationship was used to estimate evaporation from the trees on a ground area basis. The results suggest that uptake of water by the trees was limited mainly to the unsaturated zone and that the trees did not discharge a substantial quantity of water from the phreatic aquifer. (Author's abstract)
W84-04856

EVAPOTRANSPIRATION LOSSES OF TOMATOES UNDER DRIP AND FURROW IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 3F.
W84-04888

DIURNAL RELATIONSHIP BETWEEN EVAPOTRANSPIRATION AND LEAF WATER POTENTIAL OF FIELD-GROWN SOYBEANS,
Agricultural Research Service, Morris, MN.
D. C. Reicosky, T. C. Kaspar, and H. M. Taylor.
Agronomy Journal, Vol. 74, No. 4, p 667-673, July-August, 1982. 6 Fig, 18 Ref.

Descriptors: *Evapotranspiration, *Water potential, *Soybeans, Row spacing, Hysteresis, Diurnal variation, Irrigation effects, Canopy, Soil water.

The diurnal relationship between evapotranspiration (ET) and leaf water potential (Theta) were investigated for field grown soybeans (Glycine max) as affected by row spacing and irrigation on an Ida silt loam (fine, silty, mixed (calcareous) mesic family of Typic Udorthents). ET and Theta were determined in detail on 2 days in the 1979 growing cycle, one just preceding canopy closure (11 July) and the second at the midpod fill stage (1 August). Theta was measured by using a pressure chamber technique, and ET was measured by using a portable chamber. The relationship between Theta and ET was similar on both days, for both row-spacing treatments. Nonirrigated treatments demonstrated a slight hysteresis in the Theta ET relationship; irrigated treatments did not. The interaction of the variable root density and soil water status with depth does not allow any definte conclusions about the direct cause of the hysteresis. The ET at a given Theta was much greater on 1 August than on 11 July, probably because of an increase in soil evaporation caused by a recent rainfall and an increase in transpiration due to the increased leaf area index. The Theta ET relationship seemed to be affected more by irrigation than by row spacing. The simplified Ohm's Law analogy does not seem to adequately describe the relationship of plant water flux to resistance and potential difference under field conditions. (Moore-IVI)
W84-04986

MOISTURE DEFICITS AND GRAIN SORGHUM PERFORMANCE: EVAPOTRANSPIRATION-YIELD RELATIONSHIPS,
D. P. Garrity, D. G. Watts, C. Y. Sullivan, and J. R. Gilley.
Agronomy Journal, Vol. 74, No. 5, p 815-820, September-October, 1982. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Evapotranspiration, *Crop yield, *Sorghum, *Water deficits, *Nebraska, Water stress, Water use efficiency, Water management, Irrigation requirements.

Evapotranspiration-yield (ET-Y) functions were developed for grain sorghum (Sorghum bicolor), to provide base data for a water management improvement study in Nebraska. A modified line source sprinkler system was installed on a Valentine very fine sand (Typic Ustipsament) in west central Nebraska. In two seasons the relationship between evapotranspiration (ET) and grain yield (Y) or dry matter was linear. Evapotranspiration reduction under all conditions tested incurred some yield reduction. For a given genotype the slope of the ET-Y relationship varied greatly depending on the growth period treatment. The lowest slopes were associated with a treatment in which stress built up steadily over the entire growing season. The slope was generally much steeper when irrigation was restricted to varying degrees for only a portion of the growing season. With greater yield reductions per unit of ET deficit, the latter treatments were considered suboptimal irrigation strategies compared to a gradual stress buildup. One hybrid had a lower slope of the ET-Y relationship than the other genotypes for the treatment that provided water stress of gradually increasing severity. Percentage yield reductions were similar for all hybrids. The yield reduction ratios of the genotypes were different for the two growing seasons. Water use efficiency consistently decreased as ET declined below the maximum. Water stress, regardless of timing, tended to reduce water use efficiency. The reductions were smallest when stress increased gradually throughout the growing season. (Moore-IVI)
W84-04989

WATER DEFICITS AND MINERAL UPTAKE IN RICE,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
J. C. O'Toole, and E. P. Baldia.
Crop Science, Vol. 22, No. 6, p 1144-1150, November-December, 1982. 6 Fig, 2 Tab, 24 Ref.

Descriptors: *Rice, *Water stress, *Transpiration, *Nitrogen, *Phosphorus, *Potassium, Water poten-

tial, Evaporative demand, Soil water potential, Water potential.

Soil and plant water deficits are commonly related to decreased rate of crop evapotranspiration, but the relationship of transpiration to uptake of N, P, and K during water stress not well documented. The ratio of actual (stress) to potential (control) transpiration in conjunction with leaf and soil water potential to investigate the relationship between transpirational flux and uptake of N, P, and K by water stresses rice (Oryza sativa) grown in containers. Soil and plant water potential, transpiration rate, leaf area, dry weight, uptake of N, P and K and atmospheric evaporative demand were monitored over an 18 day drying period. Decreased transpiration rate was the most sensitive variable to water stress. Transpiration of the stress treatment differed significantly from control plants when soil water potential was in the range -0.02 to -0.15 MPa. Dawn leaf water potential, alternately used to estimate soil water potential, was between -0.06 and -.025 MPa when transpiration and N, P and K uptake of stressed plants derived from control plants. Transpiration and nutrient uptake were highly correlated during the development of even mild soil and plant water stress. Although these results must be carefully extrapolated to multilayer soil conditions, they may be relevant for young plants of many crops where the root system is not well developed vertically or where soil physical or chemical barriers limit the soil volume for root growth. (Moore-IVI)
W84-05008

EFFECT OF SOIL MOISTURE STRESS TO VARIOUS FRACTIONS OF THE ROOT SYSTEM ON TRANSPIRATION, PHOTOSYNTHESIS, AND INTERNAL WATER RELATIONS OF PEACH SEEDLINGS,
Department of Agriculture, Harrow (Ontario). Research Station.
C. S. Tan, and B. R. Buttery.
Journal of American Society of the Horticultural Science, Vol. 107, No. 5, p 845-849, 1982. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Peaches, *Water stress, *Transpiration, *Roots, Soil water, Photosynthesis, Stomatal conductance, Wilting, Xylem pressure potential, Plant growth.

Peach (Prunnus persica (L.) Batsch) seedlings were grown in large sectional boxes with root systems divided into 4 separate quadrants. Groups of peach seedlings with 3, 2, 1, and 0 quadrants of the root system deprived of water for 3 weeks, were further subjected to moisture stress in all quadrants by withholding water for 5 days, and they were then rewatered. In another treatment, seedlings were subjected to 2 cycles of water stress, applied 3 weeks apart, by completely depriving all quadrants of water until the plants wilted. Transpiration, photosynthesis, stomatal conductance, and xylem pressure potential were measured. Subjecting a large portion of the root (50%) to stress by withholding water only caused a small reduction (17%) in transpiration, photosynthesis, and stomatal conductance. Subjection of various fractions of the root system to severe moisture stress did not affect the shoot:root ratio. The reduction in root growth in dry quadrants was accompanied by the production of more roots in wet quadrants and less transpiring leaf surface and branch growth. The rate of recovery of transpiration and photosynthesis from water stress was greatly influenced by the duration and intensity of wilting as well as by the rate of regeneration of new root systems. (Author's abstract)
W84-05065

PRELIMINARY QUANTIFICATION OF THE IMPACTS OF ASPEN TO CONIFER SUCCESSION ON WATER YIELD - I. HEAT PULSE METHODOLOGY FOR MODEL CALIBRATION,
Utah State Univ., Logan. Watershed Science Unit.
W. Humphries, and G. F. Gifford.
Water Resources Bulletin, Vol. 20, No. 2, p 173-178, April, 1984. 3 Fig, 1 Tab, 42 Ref. OWRT project B-175-Utah, OWRT grant 14-34-0001-0138.

Descriptors: *Transpiration, *Heat pulse velocity, *Trees, Aspen, Fir, Spruce, Sap velocity, Plant activity index, Plant populations, Succession, Water yield.

Studies using heat pulse velocity (HPV) techniques to measure transpiration were conducted on three tree species in the Wasatch Mountains (Utah). Twenty-six aspen, 20 subalpine fir and 20 Engelmann spruce of various sizes were cut under water and suspended in permanent reservoirs at the site. The reservoirs were sealed so that all water loss was due to consumption by the trees. Sap velocities, as computed from HPV, were related to conducting areas of the tree trunks. Computed transpiration volumes were then correlated with actual water losses from the reservoirs. Coefficients of determination (R2) of 0.87, 0.86, and 0.82 were obtained for the fir, aspen, and spruce, respectively. Reservoir water loss for each species for each season was then used to adjust a plant activity index for computing transpiration within ASPCON, a model describing the hydrology of aspen to conifer succession. The plant activity index reflects the variation in the capability of a plant community to transpire water over the year. The developed correlations of actual and computed flows, as well as total and water conducting cross-sectional areas, may be somewhat site specific. (Moore-IVI)
W84-05155

DISTRIBUTION OF DEUTERIUM AND 18-O IN DRY SOILS. 1. THEORY,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
C. J. Barnes, and G. B. Allison.
Journal of Hydrology, Vol. 60, No. 1-4, p 141-156, January, 1983. 2 Fig, 13 Ref.

Descriptors: *Evaporation, *Mathematical models, Model studies, Isotope studies, Temperature, Humidity, Soil water, Slope, Arid lands.

A mathematical model is developed describing the shape of H2(18)O and HDO depth profiles which result from evaporation of water from dry soil under quasi-steady state conditions. Typically, isotope concentrations rise from a minimum at the soil surface to a maximum a short distance beneath the surface, and then decrease approximately exponentially to constant concentrations at depth. The model predicts that for isothermal conditions, the slope of the relationship between O-18 and deuterium delta-values of samples of the soil water will be about 30% lower for a dry soil than for a wet soil evaporating under the same conditions. Low slopes should be indicative of soil water or groundwater recharged under arid or semi-arid conditions. Using the shape of the O-18 and deuterium profiles, three independent methods for estimating evaporation for dry soils are developed. When water loss occurs by both transpiration and evaporation, the slope of the O(18)-D relationship should be slightly lower than that for a site where water loss occurs by evaporation alone. Each of the three methods is applicable to both D and O-18 data, so that if complete data are available, there is an independent check on each method. For a strictly equilibrium and isothermal profile, the estimate made using the decay length is probably the most accurate. However, in more complicated situations where the profile may not be in complete equilibrium, or when plants are transpiring, the concept of a decay length is irrelevant. The estimate made using the depth of the maximum delta-value is probably more robust, as it is effectively an instantaneous estimate of the evaporation rate. (Baker-IVI)
W84-05353

EVAPORATION DATA FROM A PICHE EVAPORIMETER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Physics and Meteorology.
A. F. G. Jacobs, and E. E. L. Arriens-Bekker.
Journal of Hydrology, Vol. 60, No. 1-4, p 367-380, January, 1983. 10 Fig, 7 Ref.

Descriptors: *Evaporation, *Evaporimeter, Measuring instruments, Evaporation rate, Piche evaporimeters.

Measurements have been conducted with Piche evaporimeters within a thermometer screen over a grass surface at several heights. The results show a good correlation with model calculations but differ somewhat in absolute value. With a simple factor, or with a lower measuring position, the results can be brought into better agreement. The comparison between the results of the De Vries and Venema model (De Vries, D. A. and Venema, H. J., 1953. Vegetation, 5/6: 225-234.) with the readings showed a systematic overestimate of about 30%. The model of Stigter and Uiso (Stigter, C. J., and Uiso, C. B. S., 1981. Appl. Sc. Res., 37: 213-223,) showed an underestimation of about 15%, probably caused by omitting the supplied energy term. A Piche evaporimeter is highly sensitive to wind effects which mainly will result in overestimation of evaporation data. (Baker-IVI)
W84-05367

2E. Streamflow and Runoff

CONFIDENCE INTERVALS FOR DESIGN EVENTS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger.
Journal of Hydraulic Engineering, Vol. 109, No. 1, p 13-27, January, 1983. 1 Fig, 10 Tab, 25 Ref. NSF grant CME 8010889.

Descriptors: *Confidence intervals, *Design criteria, *Floodplain management, Quantile, Flood flow, Pearson Type III distributions, Mathematical equations, Mathematical models, Mathematical studies, Flood frequency.

An important problem in hydrology is the estimation of some quantile of a streamflow or flood-flow distribution. For example, the 100-year flood, corresponding to the 99 percentile of the annual flood-flow distribution, is used in floodplain management and planning. Confidence intervals for normal, log-normal, and Pearson Type III quantiles based on asymptotic theory are shown to fail to contain the true 100-year flood and other design events with the specific frequency (confidence level). Intervals which contain normal and lognormal quantiles with the desired confidence can be constructed using the noncentral t-distribution. Tables are provided. An adjustment for the case when a variable has a Pearson Type III distribution with known skewness coefficient is suggested. Such intervals are shown to contain design events with nearly the desired level of confidence. Confidence intervals constructed using the U.S. Water Resources Council guidelines, Bulletins 17A and 17B, often did not achieve the desired confidence level. (Murphy-IVI)
W84-04821

TWO-DIMENSIONAL CHANNEL FLOWS OVER ROUGH SURFACES,
Agricultural Research Service, Oxford, MS. Sedimentation Lab.
N. L. Coleman, and C. V. Alonso.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 175-188, February, 1983. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Multiphase flow, *Channel flow, *Rough surfaces, Reynolds number, Mathematical equations, Velocity, Viscosity, Model studies.

A single equation model for pedicting the velocity profile throughout the complete inner and outer regions of channel or conduit flow is presented. The model predicts within 20% of measured data in the logarithmic zones of velocity profiles when tested against channel and conduit flows with either smooth boundaries or planar boundaries of granular material with scaled equivalent sand grain boundary roughness values ranging up to 2,075. The absolute value mean predictive error with the data sets used here was 9%. The equation predicts the velocity profile in the viscous sublayer, the buffer zone, the logarithmic or inertial zone, and

the outer or wake region in conduit and channel flows provided that secondary or crossflow is weak or absent. (Baker-IVI)
W84-04827

EFFECTIVE IMPERVIOUS AREA IN URBAN RUNOFF MODELING,
Geological Survey, Reston, VA.
W. M. Alley, and J. E. Veenhuis.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 313-319, February, 1983. 2 Tab, 11 Ref.

Descriptors: *Urban runoff, *Model studies, *Impervious areas, Runoff, Denver, Colorado, Metropolitan water management, Urban areas.

Methods of estimating impervious areas are described and some effective impervious area data is summarized. The ramifications of effective impervious area concepts in urban runoff modeling are analyzed. Results from many urban runoff models are sensitive to the value used for impervious area. Large differences in results can be obtained depending on whether total impervious area (TIA) or effective impervious area (EIA) calculations are used. TIA may be appropriate for black-box models but not for deterministic ones. Potential problems of using TIA in the more deterministic models include: runoff volumes and peak flows may be largely overestimated for ungaged watersheds; simulated changes in runoff, on a percentage basis, due to increasing intensity of land use may be smaller if TIA is used rather than EIA; and overestimates of the infiltration rates are likely if the model is calibrated using TIA and measured rainfall-runoff data. Impervious area data collected from 19 urban watersheds in the Denver metropolitan area suggest a large potential exists for developing relationships between EIA and TIA for an urban area, either through a regression equation between the two variables or through estimates of the ratio EIA-TIA as a function of land use. (Baker-IVI)
W84-04834

FLOOD FREQUENCY ANALYSIS WITH HISTORIC INFORMATION,
Inland Waters Directorate, Ottawa (Ontario).
R. Condie, and K. A. Lee.
Journal of Hydrology, Vol. 58, No. 1-2, p 47-61, August, 1982. 1 Fig, 5 Tab, 7 Ref.

Descriptors: *Flood frequency, *Frequency analysis, *History, Flood data, Mathematical studies, Regional analysis, Frequency distribution, Flood forecasting, Monte Carlo method.

Within the limits of available real data and the Monte Carlo experiment, a reliable maximum likelihood method is presented for fitting the three-parameter lognormal distribution to flood series with historic information. The maximum likelihood method, although biased, gives estimates both of parameters and T-yr. events which are substantially less biased in the absolute sense than those obtained by the more conventional method of historically weighted moments. Maximum likelihood estimates also give significantly smaller root mean square errors of estimates of parameters about their true values, although for some T-yr. events, the moment fit is better in this respect. Overall, the proposed maximum likelihood method seems preferable to the conventional method of historically weighted moments. (Baker-IVI)
W84-04838

EFFECTS OF CATCHMENT SIZE ON RUNOFF RELATIONSHIPS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim, I. Cordery, and B. C. Baron.
Journal of Hydrology, Vol. 58, No. 3/4, p 205-221, September, 1982. 3 Fig, 70 Ref.

Descriptors: *Catchment size, *Runoff, *Catchment basins, *Catchment areas, Drainage area, Unit hydrographs, Hydrographs, Rainfall-runoff relationships.

Concern has often been expressed that the hydrological processes and relationships on small catchments may not be representative of those on larger catchments, and that the relative importance of the various processes on the two types of catchments are different. The transfer of results to large catchments is of obvious practical importance. Factors that affect hydrological relationships between small and large catchments are reviewed, including the various processes and mechanisms by which runoff occurs, catchment characteristics such as land use, soils and geology, the variation of geomorphological characteristics with catchment size, small-scale nonhomogeneity of hydrological characteristics, and data errors. Hydrological responses of small catchments are likely to be different from and more variable than those of large catchments. While general relationships will exist between small and large catchments in a region, no simple or closely defined relations are likely. The transfer of many types of relationships from one region to another is also likely to be invalid. The findings of the review are illustrated by the results of an investigation of relationships between small and large catchments in eastern Australia involving annual rainfall-runoff relations, unit hydrograph parameters and storm loss rates. (Murphy-IVI)
W84-04847

SNOW-COVER AREA VS. SNOWMELT RUNOFF RELATION AND ITS DEPENDENCE ON GEOMORPHOLOGY - A STUDY FROM THE BEAS CATCHMENT (HIMALAYAS, INDIA),
Roorkee Univ. (India). Dept. of Earth Sciences.
For primary bibliographic entry see Field 2C.
W84-04854

APPLICATION OF HOT-WIRE (-FILM) FLOWMETERS TO WATER VELOCITY MEASUREMENTS IN WELLS,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
A. Tselentis.
Journal of Hydrology, Vol. 58, No. 3/4, p 375-381, September, 1982. 2 Fig, 16 Ref.

Descriptors: *Flow velocity, *Measuring instruments, *Hot-wire flowmeters, *Hot-film flowmeters, Wells, Flowmeter, Velocity, Water velocity, Flow.

Hot wires have been used for a long time for the measurement of air speeds, where they are particularly suitable for relatively small velocities. Hot wire (-film) flowmeters are by no means a panacea for well born fluid flow measurements, but the device could be valuable if made to work accurately in water. Its sensitivity increases with decreasing velocity; it could therefore be used to great advantage to measure those low velocities where an impeller flowmeter is not satisfactory. Unfortunately there are many problems to be solved and up to now thermal flowmeters can be considered to be of little practical value for water velocity measurements in wells. Presently, a new device is under theoretical and experimental investigation and has shown considerable promise in water velocity measurements as low as 1 mm/s. It uses the thermal wake of a heated wire, submerged in the water as a tracer. Important advantages of the heat-pulse method are its stability and repeatability over a wide dynamic range in a wide variety of conditions. The high electrical conductivity of water, its low boiling point, its temperature-dependent viscosity, and the large number of suspended particles found in well waters are some factors which make the behavior in water of the hot-wire (-film) flowmeter very complicated. (Baker-IVI)
W84-04858

STATISTICAL ANALYSIS OF THE DAILY STREAMFLOW HYDROGRAPHY,
Kentucky Univ., Lexington. Dept. of Civil Engineering.
M. L. Kavvas, and J. W. Delleur.
Journal of Hydrology, Vol. 71, No. 3/4, p 253-275, March, 1984. 8 Fig, 1 Tab, 14 Ref. OWRT grant OWRT-B-112-IND.

Descriptors: *Statistical analysis, *Stream discharge, *Daily hydrographs, Discharge hydrographs, Model studies, Mathematical equations, Hydrologic models, Indiana.

In planning studies of a water-resources system for water-supply, irrigation and flood-control purposes, daily or smaller-time-increment streamflows are routed through the envisaged reservoirs to evaluate their performance. A periodic statistical analysis of daily streamflow data in Indiana, U.S.A., was performed to gain some new insight into the stochastic structure which describes the daily streamflow process. This analysis was performed by the periodic mean and covariance functions of the daily streamflows, by the time and peak discharge dependent recession limb of the daily streamflow hydrograph, by the time and discharge exceedance level (DEL) dependent probability distribution of the hydrograph peak interarrival times, and by the time-dependent probability distribution of the time to peak discharge. Some new statistical estimators were developed and used in this study. In general features, this study has shown that: (a) the persistence properties of daily flows dependent on the storage state of the basin at the specified time origin of the flow process; (b) the daily streamflow process is time irreversible; (c) the probability distribution of the daily hydrograph peak interarrival time depends both on the occurrence time of the peak from which the interarrival time originates and on the discharge exceedance level; and (d) if the daily streamflow process is modeled as the release from a linear watershed storage, this release should depend on the state of the storage and on the time of the release as the persistence properties and the recession limb decay rates were observed to change with the state of the watershed storage and time. Therefore, a time-varying reservoir system needs to be considered if the daily streamflow process is to be modeled as the release from a linear watershed storage. (Murphy-IVI)
W84-04863

SPATIAL DEPENDENCY OF HYDRAULIC GEOMETRY EXPONENTS IN A SUBALPINE STREAM,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
P. J. Phillips, and J. M. Harlin.
Journal of Hydrology, Vol. 71, No. 3-4, p 277-283, March, 1984. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Hydraulic geometry, *Subalpine streams, Spatial distribution, Model studies, Streamflow, Velocity, Mathematical equations, Soil water.

Analysis of a subalpine stream in a relatively homogeneous environment indicates that hydraulic exponents are not stable over space. A question as to the applied value of this model is raised by inequalities in continuity parameters derived from the hydraulic geometry equations. It becomes exceedingly difficult to discern real meaning in hydraulic geometry exponents as the longitudinal stream profile under examination lengthens. The meadow environment examined in this study produced one set of equations, but as data were disaggregated the exponents projected little stability. It seems a clear picture of the influence from geology-soil relationships, widening and narrowing floodplains, upstream bog and marsh environments, or network topologies, is lost as hydraulic geometry is assessed over even limited channel reaches in carefully controlled environments. Employing the hydraulic geometry model to answer questions pertaining to channel storage, flood potential, or sediment delivery would seem to prove difficult at best without constant re-evaluation in steady state time. An inherent difficulty in the model is that the feedback in the system produces variables which, even in the short run and at a station are never consistently dependent or independent. (Baker-IVI)
W84-04864

CHANGES IN THE HYDROLOGIC REGIME OF THE BATTLE RIVER BASIN, ALBERTA, CANADA,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
W. J. Stolte, and R. Herrington.
Journal of Hydrology, Vol. 71, No. 3/4, p 285-301, March, 1984. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Hydrologic aspects, *Battle River basin, *Alberta, *Canada, Battle River, Net rainfall, Evapotranspiration, Drainage area, Catchment areas, Cumulative runoff, Snowmelt, Streamflow depletion, Land use.

Flow records of the Battle River, Alberta, include those taken near Ponoka for a period in the early part of the century and those taken at the same location recently. Some questions have arisen as to whether these two sets of records can properly be combined for purposes of water-resource development. An investigation was made into whether a significant decrease in flows had occurred and if so, what caused the change. The reductions in the mean monthly flow were analyzed statistically and changes identified. Variations in the precipitation regime included changes in the evapotranspiration regime and shifts in landuse and agricultural practices. Monthly flows of the Battle River near Ponoka from 1967 and 1979 were found to be significantly reduced from the level that prevailed from 1914 to 1932, except for spring flows. Spring flows remained virtually unchanged thereby indicating that the snow accumulation and snowmelt processes had not changed with time. The reductions in summer and winter flows indicated that the quickflow reponse of the basin to summer storms and also the delayed flow from soil-moisture drainage had decreased. Analysis of daily and monthly precipitation characteristics showed that changes in precipitation characteristics could not be considered responsible for most of the runoff changes. An increase in growing-season temperatures resulting in increased evapotranspiration is a possible partial cause of the decreased flows. Greatly increased use of fertilizer since 1950 has caused a substantial increase in crop yields. In all likelihood this increase has created a major increase in water use leading to a drop in soil-moisture content and then reductions in streamflow. Winter recharge of soil moisture from depth as reported in the literature were the probable reason for little change in snowmelt runoff. A lack of change and even increases in runoff production in the lower Battle River basin were due to generally lower moisture surpluses in the region, thus there was less sensitivity to fertilizer application rates, and also much lower rates of fertilizer application. (Murphy-IVI)
W84-04865

TURBULENT SHEAR-STRESSES AND VELOCITY DISTRIBUTION IN OPEN-CHANNEL FLOWS (CONTRAINTES TANGENTIELLES TURBULENTES ET DISTRIBUTION DES VITESSES DANS LES ECOULEMENTS A SURFACE LIBRE),
Rome Univ. (Italy).
B. Gaddini, and M. Morganti.
La Houille Blanche, Vol. 4, p 309-326, 1982. 11 Fig, 1 Tab, 11 Ref.

Descriptors: *Turbulent shear stresses, *Shear stress, *Velocity distribution, *Open-channel flow, Turbulent flow, Hydraulic friction, Hydraulic properties, Hydrodynamics, Velocity coeficient, Mathematical equations, Karman's constant, Boundary conditions.

To determine the velocity field and the friction factor in open-channels with sufficient accuracy, it is necessary to evaluate the effects both of the shape of the cross-section and of the non-uniform distribution of the shear-stresses over the wetted perimeter. These factors in fact determine a three-dimensional flow in open channels. Measurements of turbulent shear-stresses and of mean velocities in an open-channel flow were carried out using a hot-film anemometer. The lines of zero shear-stress on the cross-section were deduced in the case of a three-dimensional turbulent flow. On the cross-section, the lines along which shear-stresses prove to be zero in the axial direction of the flow may be taken as orthogonals to the isolvels. Even when considerable distortions of the flow fields exist, the mean axial velocity shows a logarithmic distribution along the lines of zero shear. A logarithmic law of mean velocity distribution along the lines of zero shear involves values of Karman's constant which vary along the wetted perimeter in accordance with the boundary conditions on the cross-section. (Murphy-IVI)
W84-04947

LAMINAR FLOW VELOCITY PROFILE OVER CLOSE-PACKED SPHERICAL ROUGHNESS ELEMENTS (LE PROFIL DES VITESSES EN ECOULEMENT LAMINAIRE SUR UN FOND D'ELEMENTS DE RUGOSITE SPHERIQUES JOINTIFS),
Science and Education Administration, Oxford, MS. Sedimentation Lab.
N. L. Coleman.
La Houille Blanche, Vol. 1, p 13-12, 1982. 6 Fig, 1 Tab, 7 Ref.

Descriptors: *Laminar flow, *Velocity distribution, *Close-packed roughness, *Roughness coefficient, Hydraulic roughness, Hydraulic properties, Hydraulic friction, Hydraulic profiles, Reynolds number, Reynolds model, Flow characteristics.

Laminar bounded shear flows are usually considered only with regard to flow over smooth surfaces, without roughness elements of any kind. Little is known about laminar flow over a surface with roughness elements, even though this is a situation that arises fairly often in connection with the movement of very viscous fluids through conduits of different kinds and specifically in the experimental study of low Reynolds number flow over sediment beds. Methods are presented for calculating the virtual origin correction, the local friction coefficient, and the bed shear velocity for laminar flow over close-packed spherical roughness elements. The validity of these methods is tested using measured velocity profiles from 16 laminar flows over a bed composed of close-packed spherical roughness elements in the rectangular conduit of a water tunnel. When the virtual origin correction is introduced into the equation for laminar flow between parallel boundaries, the equation universally represents the data, except for a region of deviation immediately adjacent to the roughness elements. Conversely, omission of the virtual origin correction from the equation results in error in the calculation of the bed shear velocity and in loss of universality in representation of the velocity profiles. (Murphy-IVI)
W84-04949

DOCUMENTATION OF HIGH SUMMER FLOWS ON THE POTOMAC RIVER FROM THE WOOD ANATOMY OF ASH TREES,
Geological Survey, Reston, VA. Water Resources Div.
T. M. Yanosky.
Water Resources Bulletin, Vol. 20, No. 2, p 241-250, April, 1984. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Potomac River, *Ash trees, *High flow, *Dendrochronology, Streamflow, Floodplains, Plant growth, Flow discharge, Hydrologic data, Data reconstruction.

Ash trees (Fraxinus americana L. and F. pennsylvanica Marsh.) collected from the flood plain of the Potomac River near Washington, D.C., were studied for evidence of associations between known periods of above-average summer flows and changes in wood-growth anatomy. Concentric bands of latewood fibers with atypically large lumens and thin walls commonly developed in trees growing near the low-water channel. Discharge records indicate that roots of most trees with these 'white rings' were flooded temporarily during the latewood-growth interval. Trees apparently were not damaged and a concomitant reduced of internal water stresses seems to have accelerated the rate of radial growth. The intraring position of anomalous fibers generally corresponded to the time of increased discharge within the estimated interval of latewood growth. Anomalous fibers occasionally formed in unflooded trees, but their position also coincided with episodes of increased discharge. The results of these studies may have applications for stream-flow reconstruction techniques where hydrologic data are incomplete or lacking. (Author's abstract)
W84-05165

INLET CONCENTRATION TIME NOMOGRAM FOR URBAN BASINS,
Old Dominion Univ., Norfolk, VA. Dept. of Civil Engineering.
A. P. Akan.
Water Resources Bulletin, Vol. 20, No. 2, p 267-270, April, 1984. 3 Fig, 8 Ref.

Descriptors: *Urban runoff, *Kinematic waves, Inlet concentration time, Nomogram, Surface runoff, Drainage, Rainfall intensity, Rainfall, Storm runoff.

Inlet concentration time represents the longest travel time to an inlet for surface runoff. A physically based nomogram to determine inlet concentration times for composite developed basins is presented. The nomogram is constructed from previously derived kinematic wave formulations of both catchment and gutter flow components of surface runoff. With specified physical properties of a basin and rainfall intensity duration relationships the inlet time can be obtained from the nomogram directly. As the proposed method is physically based, it is applicable not merely to a certain region or to special flow conditions. It can be employed for a variety of different types of composite basins within the limitations of the kinematic-wave theory. The method requires detailed information for each drainage area, but all the parameters involved are defined reasonably well and can be either measured or obtained from widely used tables. Such information would be needed even if an empirical formula were adopted to calculate inlet concentration times. The nomogram derived is especially useful when a city engineer or design engineer must repeat the process of calculating the inlet concentration time for many widely varied areas within a city or subdivision. (Baker-IVI)
W84-05168

FLOOD ESTIMATION IN GREAT BRITAIN (BESTIMMUNG DER HOCHWASSERABFLUSSE IN GROSSBRITANNIEN),
Institute of Hydrology, Wallingford (England).
M. A. Beran.
Wasserwirtschaft, Vol. 73, No. 4, p 120-125, April, 1983. 3 Fig, 1 Tab, 3 Ref.

Descriptors: *Flood studies report, *Flood forecasting, *Flood estimating, Flood hydrographs, Flood data, Flood profiles, Flood protection, Flood recurrence interval, Great Britain, Hydrologic models.

A very large program of research to frame recommendations for flood prediction which culminated with the Flood Studies Report is described. Although this report has found ready application in Britain many important questions were unanswered. This has prompted an extension incorporating data from mainland Europe. Current activities of the European Flood Study are also described. The study develops regional flood curves for Britain and Ireland. The program categorizes or rates the possible flood conditions. (Murphy-IVI)
W84-05239

DIFFUSION AND DISPERSION IN STREAMS (DIFFUSION UND DISPERSION IN FLUSSEN),
Karlsruhe Univ. (Germany, F.R.).
J. Grimm-Strele.
Wasserwirtschaft, Vol. 73, No. 11, p 380-385, November, 1983. 8 Fig, 2 Tab, 19 Ref.

Descriptors: *Diffusion coefficient, *Dispersion coefficient, *Flow characteristics, Mixing phenomena, Mixing capacity, Mathematic analysis, Mathematic models, River flow, River mechanics.

Dispersion models are helpful in assessing river flow suppression. Field experiments of mixing phenomena in rivers indicated a large increase in the mixing capacity in some of the sharp bends. In further laboratory experiments the mixing in straight flumes and the exchange between river and lateral dead zones was investigated. Numerical and graphical analysis is represented illustrating pertinent mixing coefficients. (Murphy-IVI)
W84-05256

NUMERICAL CALCULATION OF TURBULENT TRANSPORT PROCESSES IN WATER BODIES (NUMERISCHE BERECHNUNG TURBULENTER AUSBREITUNGSBORGANGE IN GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 5B.
W84-05257

FLASH FLOOD OF JULY 1979 IN THE LUNI BASIN - A RARE EVENT IN THE INDIAN DESERT,
Central Arid Zone Research Inst., Jodhpur (India).
K. D. Sharma, and N. S. Vangani.
Hydrological Sciences Journal, Vol. 27, No. 3, p 385-397, September, 1982. 10 Fig, 4 Tab, 13 Ref.

Descriptors: *Flash floods, *Luni Basin, *India, *Arid zone, Monsoons, Soil saturation, Suspended sediments, Stream erosion, Scour, Dissolved solids.

A well marked low pressure monsoon depression caused unprecedented heavy rainfall of five days duration (15-19 July 1979) in the Luni basin in the India arid zone. It caused the worst flash flood in living memory. Saturated antecedent soil moisture conditions, thin soil cover underlain by bed rock or hardpan, a larger area of exposed rocks in the basin and failure of the earthen reservoirs further worsened the flood effect. During flooding, suspended sediment concentrations rose from 0.86 to 40.2 g/l downstream due to bank scouring, erosion and high transmission losses of the runoff volume in the alluvial channels. The dilution effect of flooding caused lower concentrations of the total dissolved solids which increased with downstream travel. Social effects of this flood and consequences on future planning in the Luni basin have also been discussed. (Author's abstract)
W84-05294

STREAMFLOW GENERATION REGARDING STORAGE COMPONENTS AND RUNS' CHARACTERISTICS,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and H. K. M. Vithana.
Journal of Hydrology, Vol. 60, No. 1-4, p 1-12, January, 1983. 2 Fig, 3 Tab, 19 Ref.

Descriptors: *Storage reservoirs, *Model studies, *Streamflow, Hydrologic models, Performance evaluation.

An attempt is made to search for a model which is capable of reproducing the reservoir storage components and runs' characteristics along with the mean, standard deviation, skewness and correlation coefficients of historical monthly streamflows. The model is based on the method of fragments and a scheme devised for annual values yields satisfactory results and is recommended for use. The method is simple in form and easy to employ. Results are presented of the case of a station on the Pking River at Nawarat Bridge, Thailand. (Baker-IVI)
W84-05345

STREAMFLOW FORECASTING IN REMOTE AREAS,
Roorkee Univ. (India). Dept. of Civil Engineering.
K. P. Sharma, and R. H. McCuen.
Journal of Hydrology, Vol. 60, No. 1-4, p 13-23, January, 1983. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Streamflow, *Forecasting, *Model studies, Hydrologic models, Watersheds, India, Remote areas, Remote sensing, Sont Watershed, Muna Watershed.

There is a need to develop and test hydrological models that require a minimal input data base; are conceptually simple, and therefore easy to transfer; and are valid for large watersheds, many of which are in remote areas. It is also advantageous to have a model that can use remotely sensed data as a major input. Data are used from two watersheds in India to compare a selection of model structures, calibrate a distributed seasonally-varying model, and test the model with data that were independent of the data used to calibrate it. The study was limited to the analysis of water supply forecasting models that require only the size of the watershed, the land use, and estimates of the volume of precipitation. Both lumped and distributed models were tested, but only the spatially distributed ones provided reasonable estimates of runoff volumes. Model structures tested included multiplicative linear and exponential forms. Both seasonally varying and time independent land use coefficients were tested. The calibration and testing on the 7500 sq km Sont and Muna watersheds suggested that reliable forecasts can be made using the multiplicative linear model form utilizing a spatial separation of the watershed such that the precipitation and land use effects are relatively uniform within the subarea. Seasonal adjustment of the land use coefficients will further improve the overall accuracy of the water supply forecasts. (Baker-IVI)
W84-05346

CONDITIONS GOVERNING THE USE OF APPROXIMATIONS FOR THE SAINT-VENANT EQUATIONS FOR SHALLOW SURFACE WATER FLOW,
Institute of Hydrology, Wallingford (England).
J. H. Daluz Vieira.
Journal of Hydrology, Vol. 60, No. 1-4, p 43-58, January, 1983. 10 Fig, 6 Ref.

Descriptors: *Waves, *Overland flow, *Model studies, Mathematical equations, Saint-Venant Equations, Surface flow, Channels, Kinematic waves.

The propagation of shallow waves in open channel or overland flow can be described by the full Saint-Venant equations. The two parameters which govern these two equations are the Froude number and the kinematic wave number. An attempt is made to determine whether approximations of these two parameters can be used for certain values of these parameters. The solutions of the Saint-Venant equations are compared with those of the kinematic, diffusion and gravity wave approximations, for a range of constant Froude and kinematic wave numbers, with two different lower boundary conditions: critical flow, and zero depth gradient. Constant lateral inflow is assumed. (Baker-IVI)
W84-05348

MODELS OF STREAM BED TOPOGRAPHY AT THE REACH SCALE,
Sheffield Univ. (England). Dept. of Geography.
A. D. Knighton.
Journal of Hydrology, Vol. 60, No. 1-4, p 105-121, January, 1983. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Channels, *Topography, *Stream beds, Model studies, Energy, Meanders, Riffles.

A simple model of channel geometry is presented which focuses on the way that a single form variable may be autocorrelated with upstream values of the variable and which is amenable to analysis using time series methods. Stream bed topography at the local scale is the variable of interest. Bed height series were obtained for four stream lengths located at different positions along a mountain stream to test the hypothesis that, as control variables change partially, the form of the model will also change. The Box-Jenkins models describing the series are dominated by autoregressive terms and indicate a non-random variation of bed height. An increase in the order and parameter magnitude of the models is associated with an increase in discharge and a decrease in bed material size, suggesting that the structure of the model reflects the adjustability of the stream bed and, specifically, the extent of riffle-pool development, although channel gradients may be too high for a well-defined riffle-pool sequence to be developed. Changes in the parameter structure of the models describing the bed height series appear to reflect changes in the ability of the stream to adjust its local bed topography. As discharge increases and bed material size decreases, the magnitude of the autoregressive parameters and the order of the model increase. There is a corresponding change also in the extent to which the stream has developed a riffle-pool bed. Because the riffle-pool sequence has been associated with meander development and the way in which a stream consumes its energy, these parametric models may be useful indicators of the patterns of energy availabilty and utilization in natural streams. Although the sample is small, the analysis does suggest that even in a relatively short stream there are marked longitudinal variations in the adjustability of channel bed form. (Baker-IVI)
W84-05351

ASSESSMENT OF THE R-INDEX METHOD FOR CALCULATING STORMFLOW VOLUMES IN NATAL, SOUTH AFRICA,
Zululand Univ., Empangeni (South Africa). Hydrological Research Unit.
A. S. Hope.
Journal of Hydrology, Vol. 60, No. 1-4, p 143-155, January, 1983. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Storm runoff, *Catchment areas, Model studies, Simulation, Antecedent moisture, Antecedent rainfall, Natal, South Africa, R-index method, Precipitation.

The R-index method was developed to calculate stormflow volumes and peak discharge rates from small forested and wildland catchments, The possible adaptation of this method for calculating stormflow volumes from small catchments in Natal, South Africa was investigated. Following a description of the R-index method, procedures for testing the model on selected catchments in Natal are outlined. Initial flow rate and a seasonal variable are given as alternative indices for estimating antecedent moisture conditions for the R-index method, procedures which are unsuitable for the widespread use of this method in Natal. The R-index method, using initial flow rate as an input for antecendent moisture conditions, simulated stormflows accurately for the selected catchments in Natal. Similar stormflow producing mechanisms appear to operate in the eastern U.S.A. and Zululand resulting in similar model parameters for the two regions. The accuracy of this method for stormflow simulations in both regions indicates that the major variables responsible for stormflow production are well accounted for in the model. In catchments where the streams are non-perennial or intermittent, the initial flow rate is an unsuitable variable for representing antecedent moisture conditions as many stormflow events are preceded by zero flow. General similarity in parameter values may result in more accurate stormflow simulations than exact estimates of two parameters and a substantial deviation in the third. Antecedent rainfall is a good substitute for the initial flow rate as a measure of catchment moisture status and in some cases is as good or better than the initial flow rate for stormflow prediction. The total antecedent rainfall over 15 days appears to be the most suitable index of catchment moisture status for including in the R-index method for stormflow estimates in Natal. (Baker-IVI)
W84-05360

2F. Groundwater

SOLUTIONS FOR SOLUTE TRANSPORT IN AN UNCONFINED AQUIFER,
James Cook Univ. of North Queensland, Townsville (Australia).
V. Guvanasen, and R. E. Volker.
Journal of Hydrology, Vol. 58, No. 1-2, p 89-102, August, 1982. 6 Fig, 1 Tab, 20 Ref.

Descriptors: *Solute transport, *Unconfined aquifers, Aquifer management, Groundwater re-

high-temperature zone propagates downward with decreasing intensity and with some time lags to deeper soil layers. In the same manner, when the soil surface is subject to both solar radiation and wind, increased evaporation occurs from the soil and a zone of upward flux is formed near the soil surface. This zone of upward flux may propagate to deeper soil layers. A numerical model of boundary layers between soil and atmosphere is developed, which simulates soil-water movement during drying in a nonhomogeneous bare soil. A modified and extended form of Philip and de Vries' equations for soil-water and heat flows is deduced in the present study. The results of numerical simulation are compared with the data obtained from field observations in a volcanic ash soil in Japan called Kanto loam. The computed profiles agree fairly well with those of the field observations for a simulated period of 35 hr., following rain. The results are summarized as follows: directions of total moisture fluxes are upward above a depth of 35 cm; upward total moisture fluxes appear to decrease with depth from the soil surface to 35 cm; directions of total moisture fluxes are always downward below 35 cm; isothermal liquid fluxes contribute much to the total moisture fluxes in all stages of the computation at every depth; isothermal vapor fluxes are negligible; thermal moisture fluxes are negligible below a depth of 30 cm, where diurnal soil temperature variations are quickly damped; directions of thermal moisture fluxes appear downward in the daytime and upward at night; magnitudes of thermal liquid fluxes are larger than those of thermal vapor fluxes. (Murphy-IVI)
W84-04866

DECAY OF A DISTURBED FREE SURFACE IN A LAYERED POROUS MEDIUM,
Oslo Univ. (Norway). Dept. of Mechanics.
P. A. Tyvand.
Journal of Hydrology, Vol. 71, No. 3/4, p 377-382, March, 1984. 2 Fig, 3 Ref.

Descriptors: *Porous media, *Free surfaces, Gravitational water, Decay rate, Flow, Mathematical equations, Permeability, Fluid mechanics.

The gravitational decay of a free surface of fluid within a porous medium is studied theoretically. The porous medium consists of two superimposed horizontal layers of different permeabilities, resting on an impermeable bottom. A formula for the decay rate is found valid for small amplitudes of disturbance. Some general trends were deduced from the findings. A disturbance never penetrates significantly into a depth larger than its own wavelength, so a layering at a larger depth is beyond the reach of the disturbance, and may be disregarded. But a layering within this reach may be of great importance. The most important layer is that of maximum permeability. If this happens to be the top layer, the decay rate is usually of the same order of magnitude as if the permeability of the other layers is neglected. But if a layer below the surface has maximum permeability, it may drastically increase the decay rate compared to that of the uppermost layer alone. This is particularly important for disturbances of long wavelengths, and has hydrological relevance to long-range levelling of a groundwater table. (Baker-IVI)
W84-04869

PROFILES OF BROMIDE AND INCREASED SOIL MOISTURE AFTER INFILTRATION INTO SOILS WITH MACROPORES,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
P. F. Germann, W. M. Edwards, and L. B. Owens.
Soil Science Society of America Journal, Vol. 48, No. 2, p 237-244, March-April, 1984. 8 Fig, 6 Tab, 31 Ref.

Descriptors: *Hydraulic profiles, *Bromide, *Soil water, *Infiltration, *Macropores, Particle size, Hydraulic permeability, Soil water potential, Soil profiles.

The purpose of this study was to investigate bromide and water distributions in soils as the result of macropore structure and sprinkling rate. Water was found to have moved laterally from the macropores into the soil matrix. It also has moved deeper into the soil with higher macroporosity and when applied at higher rates, as was indicated by bromide tracer profiles. Evidence is presented that the soil volume measured with a double tube gamma-ray probe was too small to follow the wetting process completely when macropores contributed to flow. A parameter, derived from the bromide profiles, can be used to characterize the hydraulic importance of macroporosity, based upon a simple approach to water flow along macropores. (Author's abstract)
W84-04871

FLUX-CONCENTRATION RELATION-BASED SOLUTION OF CONSTANT-FLUX INFILTRATION EQUATION: I. INFILTRATION INTO NONUNIFORM INITIAL MOISTURE PROFILES,
Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
J. F. Boulier, J. Touma, and M. Vauclin.
Soil Science Society of America Journal, Vol. 48, No. 2, p 245-251, March-April, 1984. 7 Fig, 22 Ref.

Descriptors: *Infiltration equation, *Moisture profiles, *Infiltration, Ponding, Permeability coefficient, Richards' equation, Gamma ray, Numerical analysis.

The quasi-analytical solution of the infiltration equation based on the flux-concentration relation for constant flux condition and initially uniform water content profile is extended here to nonuniform moisture profiles for fluxes either smaller or greater than the saturated hydraulic conductivity. In the latter case, the solution is developed for the postponding stage. The measured flux-concentration relation is well-approximated and no significant time dependence can be observed. The quasi-analytical solution is then successfully compared with both laboratory experiments performed on a sandy soil column and numerical solution of the Richards equation for the nonponding, prepond-ing, and postponding stages of infiltration. (Murphy-IVI)
W84-04872

STEADY INFILTRATION FROM CIRCULAR CYLINDRICAL CAVITIES,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Soil Science Society of America Journal, Vol. 48, No. 2, p 270-278, March-April, 1984. 10 Fig, 1 Tab, 28 Ref.

Descriptors: *Steady infiltration, *Circular cylindrical cavities, *Cavitation, Infiltration, Infiltration rate, Infiltration coefficient, Gravity flow, Mathematical equations, Water potential.

The problem of quasilinearized steady infiltration from circular cylindrical cavities, with the moisture potential fixed at the cavity surface, is solved exactly. Solutions are presented numerically and graphically for values of the dimensionless cavity radius, Ro, ranging from 0.01 to 10. The dependence on Ro of the average infiltration rate around the cavity surface, and of the distributions of moisture content and potential, are examined. As Ro increases, the effects of gravity on the phenomenon increasingly dominate those of capillarity. Gravity very strongly distorts the moisture distributions from the symmetry produced by capillarity alone: for Ro as small as 0.01, the depth of the effectively wetted region exceeds 250 times its horizontal width on the cavity center line; and the ratio increases rapidly with Ro, exceeding 50,000 for Ro = 5. An earlier small Ro approximation proves useful only for Ro < or = 0.2. The cavity flow, evaluated by the present analysis, may be combined with the line source solution to give approximate results useful for the region deeper than 50 radii below the cavity. (Author's abstract)
W84-04876

DIVISION S-6-SOIL AND WATER MANAGEMENT AND CONSERVATION; TEMPERATURE AND MOISTURE REGIMES IN SOILS MULCHED WITH TRANSPARENT POLYETHYLENE,
Hebrew Univ., Rehovoth (Israel). Faculty of Agriculture.
Y. Mahrer, O. Naot, E. Rawitz, and J. Katan.
Soil Science Society of America Journal, Vol. 48, No. 2, p 362-367, March-April, 1984. 7 Fig, 28 Ref.

Descriptors: *Moisture profiles, *Soil temperature, *Soil water management, *Soil water conservation, Mulches, Polyethylene, Hydraulic models, Microclimate, Soil water potential, Rehovot sand soil, Clay soil.

Solar heating of soils by mulching (tarping) with transparent polyethylene is widely used in agriculture, for heating soil during cool seasons. A numerical one-dimensional model was developed in order to study the effect of soil mulching with transparent polyethylene film upon the soil moisture and temperature regimes. Environmental conditions, soil physical characteristics, and optical properties of the cover are considered. Calculated moisture and temperature profiles were compared with observed ones in experimental field plots. It was shown that soil moisture and temperature distributions are significantly influenced by the polyethylene mulch. The numerical model accurately predicts the soil moisture and temperature regimes in two tested soils. In both a Rehovot sand soil and a light clay soil, experimental and calculated results showed that the temperature maxima of the soil increase with increasing soil moisture content. In the light clay soil both the experimental and numerical results showed that the tarping of the soil with transparent polyethylene caused a significant increase in soil moisture in the upper soil layer. At close to air-dry moisture content, the maximum temperature of the light clay soil indicated a much higher value than the wettest mulched plot of the same soil. Physically based explanations are given for the measured and computed results. (Murphy-IVI)
W84-04877

FIELD SYSTEM FOR AUTOMATICALLY MEASURING SOIL WATER POTENTIAL,
Alabama Agricultural Experiment Station, Auburn.
F. L. Long.
Soil Science, Vol. 137, No. 4, p 227-230, April, 1984. 2 Fig, 12 Ref.

Descriptors: *Soil water potential, *Measuring instruments, *Computers, Automation, Water potentials, Soil water, Electrical equipment, Tensiometers, Dataloggers.

A system is described which will automatically read soil tensiometers. The system uses a vacuum transducer on each tensiometer whose output voltage varies linearly with the amount of tension in the tensiometer. A datalogger is programmed to scan the transducers at selected intervals and record the information on cassette tape. The information is then transferred to a large computer for calculations and plotting of soil water potential with time. The system is battery operated, weatherproof, and suitable for use under field conditions. The datalogger is programmable to read the tensiometers at selected intervals, proper intervals depending on the objective of the study. The cost of the datalogger, including the interface, is about $8000. The cost of the transducers is about $90 each. The cost of tensiometers varies with length, but the average is about $30 each, which consists of the body, cap, and sensing tip. The cost of a system similar to the one described, consisting of datalogger, interface, tensiometers, transducers, wiring, etc., would total about $15,000. The increased accuracy obtainable with this system and the ability to ascertain small changes in soil water potential as a result of environmental changes should be considered. (Baker-IVI)
W84-04880

SOIL CHEMICAL AND PHYSICAL EFFECTS ON SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy.
R. J. Wagenet, R. E. Knighton, and E. Bressler.
Soil Science, Vol. 137, No. 4, p 252-262, April, 1984. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Soil chemistry, *Soil physical properties, *Spatial distribution, *Permeability coefficient, Salinity, Soil texture, Mathematical studies, Linear regression, Correlation analysis, Soil water, Soil water potential, Kidman sandy loam.

The influence of spatial variation in soil salinity and texture upon the spatial variability in hydraulic conductivity of a Kidman sandy loam soil was determined using a statistical technique based on linear regression and correlation analysis. Field-measured values of Ko and beta were obtained by an approximate technique for estimating soil hydraulic properties. Soil samples were analyzed for EC, SAR, and percentages of sand, silt, and clay. The variations in EC and percentage of sand were chosen as most influencing Ko and beta. The variations in EC explained only 19 and 7% of the variation in Ko and beta, respectively, and the percentage of sand explained about 3 and 15% of the variation in the same two parameters. Unspecified effects were responsible for about 75% of the variation in both Ko and beta, suggesting that measurement methods or assumptions in developing K(theta) were partially responsible. (Murphy-IVI)
W84-04881

IN SITU DETERMINATION OF HYDRAULIC CONDUCTIVITY IN THE VADOSE ZONE USING BOREHOLE INFILTRATION TESTS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens, S. P. Neuman, S. Tyler, K. Larnert, and D. Watson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 181081, Price codes: A09 in paper copy, A01 in microfiche. New Mexico Water Resources Research Institute Technical Report No. 180, Las Cruces, March, 1984. 174 p, 62 Fig, 13 Tab, 48 Ref.

Descriptors: *Hydraulic conductivity, *Infiltration, Borehole, Permeameter, Capillary conductivity, Carbon dioxide.

Predicting the rate of water movement above a water table is a crucial problem in hazardous and radioactive waste disposal, in the design of dams, and in the irrigation and drainage of agricultural land. Hydraulic conductivity, the key soil characteristic governing the rate of water movement, was determined in the field using constant head borehold infiltration tests. Earlier results of numerical simulations of the saturated-unsaturated flow process were verified; these indicate that only a finite zone of soil immediately surrounding the borehole is nearly saturated. Carbon dioxide injected into the borehole prior to water infiltration is an effective means to reduce the amount of entrapped air and reduce the water volume required to complete a test. New empirical solutions were developed to account for capillary effects. The borehole test results generally compared favorably with other field techniques which are restricted in application to the near surface, and also with laboratory permeameter experiments on Shelby tube samples. Laboratory permeameter experiments on small ring samples (100cc) produced consistently greater values of saturated hydraulic conductivity than other methods.
W84-04884

TOTAL RESISTANCE TO WATER FLOW IN FIELD SOYBEANS: II. LIMITING SOIL MOISTURE,
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 2I.
W84-04977

SALT DISTRIBUTION AND WATER CONSUMPTION FROM A WATER TABLE WITH AND WITHOUT A CROP,
Iowa State Univ., Ames. Dept. of Agronomy.
H. H. Saleh, and F. R. Troeh.
Agronomy Journal, Vol. 74, No. 2, p 321-324, March-April, 1982. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Salinization, *Saline soils, *Water table, *Water use, Sudangrass, Groundwater, Saline water, Crop production.

The upward movement of saline groundwater and its subsequent evaporation and transpiration are important factors in soil salinity. The permanence of irrigation agriculture requires that soil salinity be controlled. The soil salinization process was quantified and related to soil depth, cropping, and water table variables. Data were gathered by measuring the upward movement of water and salt from simulated groundwater. The work was done with 30-cm square soil columns 50 and 75-cm tall that were suspended in trays of artificial groundwater, located in a greenhouse to create an arid environment. Low salinity groundwater containing 0.23% salt (electrical conductivity 4 mmhos/cm) and high salinity groundwater containing 0.68% salt (electrical conductivity 11 mmhos/cm) were used. Sudangrass (Sorghum sudanense) was grown on half of the columns and the others were fallowed. Sudangrass production ranged from 16 g of dry matter per 50-cm column with high salinity groundwater to 37 g per 75-cm column with low salinity groundwater. Water consumption was increased by the shallower depth to groundwater, by the less saline groundwater and by the presence of a crop. The crop had little effect on the salt concentration at the moist surface of the 50-cm columns but reduced the salt accumulation at the already drier and less salty surfaces of the taller columns. Salt accumulation in the root zone was increased by the presence of a crop. (Moore-IVI)
W84-04980

SOIL AVAILABLE WATER AS INFLUENCED BY LANDSCAPE POSITION AND ASPECT,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
A. Y. Hanna, P. W. Harlan, and D. T. Lewis.
Agronomy Journal, Vol. 74, No. 6, p 999-1004, November-December, 1982. 3 Fig, 5 Tab, 19 Ref.

Descriptors: *Slope, *Aspect, *Available water, *Nebraska, Soil water, Dryland farming, Water storage, Topography.

In dryland farming, stored soil water is an essential source of water for crop production. The amount of water available for storage and crop use in a particular soil in hillslope topography is affected by its position on the landscape. The effect of slope aspect and position on soil water and its changes throughout the year in dryland farming were studied in southeast Nebraska. North, south, and east-facing slopes of Wymore silty clay loam (Aquic Argiudolls fine, montmorillonitic mesic) were selected for study. Four positions on each slope including summit, shoulder, backslope, and footslope were identified. Water content of the soil from 0 to 150 cm depth in 30 cm increments was measured weekly by neutron scattering for 2 years. Daily precipitation was recorded. Twenty percent more water was available in soils on the north-facing slope than in soils on the south-facing slope at planting and throughout the year. Soils on the east-facing slope were the driest. They contained 50% less available water than did those on the north-facing slope. Within slope positions, soils on the footslopes and backslopes contained an average of 4 cm more available water than soils on the summits and shoulders. Soil water sampling at planting time for crop management and yield prediction models should be done according to slope position. (Author's abstract)
W84-04996

EFFECT OF LANDSCAPE POSITION AND ASPECT ON SOIL WATER RECHARGE,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
A. Y. Hanna, P. W. Harlan, and D. T. Lewis.
Agronomy Journal, Vol. 75, No. 1, p 57-60, January-February, 1983. 1 Fig, 5 Tab, 13 Ref.

Descriptors: *Slope, *Aspect, *Soil water recharge, *Nebraska, Dryland farming, Water storage, Seasonal variation, Available water, Rainfall.

The effect of landscape position and slope aspect on soil water recharge under dryland farming was studied in southeast Nebraska. North, south, and east-facing slopes of Wymore silty clay loam (fine, montmorillonitic, mesic Aquic Argiudoll) were selected. Four positions were identified on each slope, namely, summit, shoulder, backslope, and footslope. Water content of the soil from 0 to 150 cm depth in 30 cm increments were measured weekly by neutron probe for 2 years. Daily precipitation was recorded. Soils of the north-facing slope were 10% less efficient in recharge of available water than soils on south- and east-facing slopes during all recharge periods. Soils on footslopes were 6 to 8% more efficient than other positions throughout the year. Water storage efficiency of the soil appeared to be higher in fall than in spring. Available water recharge was 9% more efficient during the fall than during the winter-spring period in all soils regardless of slope aspects and positions. High correlation coefficients (r) existed when soil available water was related to rainfall in either fall or spring recharge period. (Author's abstract)
W84-04998

IRRIGATION SCHEDULING I: CROP AND SOIL PARAMETERS,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W84-05005

IRRIGATION SCHEDULING II: SIMPLE, LOW COST TECHNIQUES,
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W84-05006

IN SITU DETERMINATION OF THE HYDRODYNAMIC DISPERSION COEFFICIENT AND ITS CORRELATION UNDER LABORATORY AND FIELD CONDITIONS,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Batta, and V. V. N. Murty.
Journal of Hydrology, Vol. 59, No. 1-2, p 139-147, October, 1982. 5 Fig, 3 Tab, 4 Ref.

Descriptors: *Hydrodynamic dispersion, *Soil properties, Dispersion, Soil water, Solute transport.

Determination of the hydrodynamic dispersion coefficient is often done in the laboratory, using columns of artificially-packed disturbed soil. Disturbed soils and undisturbed natural soils exhibit a marked difference in their behavior because differences in bulk densities, water retention and infiltration characteristics alter the value of the dispersion coefficient. Experiments were conducted on undisturbed and disturbed samples to find the effect of medium disturbance on the hydrodynamic dispersion coefficient under laboratory and field conditions. A method to determine the dispersion coefficient uses finite differences; the values obtained with this method were found to compare favorably with other existing methods. Disturbance of a sandy loam caused a reduction of the dispersion coefficient to approximately 0.6-0.8 of its in situ value. The dispersion coefficients for undisturbed samples for different sites vary significantly (range 0.0640-0.0799 sq cm/min) while for the disturbed samples the variation is small (0.0470-0.0511 sq cm/min); this may be attributed to better control of variables in the laboratory than in field experiments. (Moore-IVI)
W84-05131

OPERATIONAL SIGNIFICANCE OF THE CONTINUUM HYPOTHESIS IN THE THEORY OF WATER MOVEMENT THROUGH SOILS AND AQUIFERS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
P. Baveye, and G. Sposito.

Water Resources Research, Vol. 20, No. 5, p 521-530, May, 1984. 2 Fig, 48 Ref. National Science Foundation Grant CEE 79-20778.

Descriptors: *Soil water, *Mathematical equations, Water transport, Porosity, Soil properties.

The operational meaning of the representative elementary volume concept (REV, on which current foundational theories of water movement through porous media are based, is critically analyzed. The concept of REV has been developed in a number of different rationalizations, but most of them take advantage of an assumed indifference property and limit their discussion to the invariance property as applied, for example, to the mass density of some constituent or to the porosity of the medium - either soil or aquifer material. Possibly because of its broad intuitive appeal and obvious connection with continuum hypothesis, the concept of the REV seldom has been examined critically. The lack of experimental verification, and perhaps, even of the possibility of experimental verification, of the hypothetical behavior illustrated by example casts serious doubt on the existence of the spatial invariance property of the REV for real porous media. A similar concern can be expressed for the time-invariance property. Such questions can be extended to its assumed indifference property as well. It is concluded that the REV concept as applied to real porous media is both unnecessarily restrictive and experimentally unverifiable. In its place a relativist concept is proposed in which macroscopic physical variables are defined as convolution products of microscopic properties of a porous medium with weighting functions that represent the appropriate measuring instruments. The effects of resolution and precision differences among experimental measuring devices can be incorporated naturally within the relativist concept but are excluded a priori in the REV concept. The relativist point of view has a clear operational meaning and extends theoretical validity to all local measurements made on porous media. It is sufficient mathematically to derive conventional macroscopic balance equations for mass and linear momentum as well as a differential equation for the isothermal transport of water through an unsaturated, anisotropic, deformable soil or aquifer. (Baker-IVI)
W84-05326

SURFACE INFILTRATION IN SALT MARSHES: THEORY, MEASUREMENT, AND BIOGEOCHEMICAL IMPLICATIONS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
H. F. Hemond, W. K. Nuttle, R. W. Burke, and K. D. Stolzenbach.
Water Resources Research, Vol. 20, No. 5, p 591-600, May, 1984. 10 Fig, 25 Ref. NOAA, Dept. of Commerce grant 04-7-158-44079.

Descriptors: *Infiltration, *Model studies, *Salt marshes, Tidal effects, Flooding.

An analysis of surface infiltration resulting from tidal flooding in a water saturated salt marsh is presented. The concepts related to a saturated compressible soil are used to fomulate a theoretical model for infiltration based on conventional relationships between water movement, pore pressure, and water storage. Through observations of subsurface piezometric head, an estimate of the magnitude of infiltration due to tidal flooding in a salt marsh is obtained. Finally, direct seepage meter measurements of water movement across the peat surface are presented. Implications for marsh ecological processes are briefly discussed. (Baker-IVI)
W84-05332

MOLECULAR DYNAMICS AND STATISTICAL MECHANICS OF WATER NEAR AN UNCHARGED SILICATE SURFACE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
D. J. Mulla, J. H. Cushman, and P. F. Low.
Water Resources Research, Vol. 20, No. 5, p 619-628, May, 1984. 12 Fig, 74 Ref.

Descriptors: *Molecular structure, *Solute transport, Colloids, Porosity, Swelling, Clay, Silicates, Mathematical equations, Transport, Saturated soils, Unsaturated soils, Soil properties, Vicinal water.

The mechanics that lead to clay swelling and the range of perturbation in vicinal water structure that may affect diffusion on clay surfaces and dispersion in clay-water systems are investigated. Statistical mechanics were used to interpret position and velocity trajectories computed in the molecular dynamics simulation. The results of the simulation indicate that the vicinal water differs substantially from bulk water over appreciable distances for the static orientation of molecular dipole moments and the rate of relaxation of these moments and substantially over smaller distances for hydrogen bonding patterns and the rate of self-diffusion. No significant differences between the radial distribution functions of vicinal and bulk water are evident. Because vicinal water may be perturbed to large distances from a clay surface, great care must be taken in deriving transport equations in saturated and unsaturated media which are high in clay. It would appear that a satisfactory derivation of the solute transport equations in systems high in colloids and having low water content does not exist. (Baker-IVI)
W84-05334

ASPECTS OF QUASILINEAR INFILTRATION FROM SURFACE SOURCES, ESPECIALLY THE CASE ALPHA = 0,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research, Vol. 20, No. 5, p 633-635, May, 1984. 8 Ref.

Descriptors: *Infiltration, *Mathematical equations, Flow, Unsaturated soils, Saturated soils.

A number of issues are treated concerning the quasilinear analysis of steady two-and three-dimensional flows in homogeneous unsaturated soils. These issues are of general significance, though they bear specifically on three papers (Batu, V., and W. R. Gardner, Soil, Sci. Soc. Am. J., Vol. 42, p. 18-22, 1978; Batu, V., J. Irrig. Drain. Div. Am. Soc. Civ. Eng., Vol. 105(IR3), 233-245, 1979; and Batu, V., Flow Net for Unsaturated Infiltration from Periodic Strip Sources, Water Resour. Res., Vol. 16, p 284-288, 1980) which give a misleading picture of the mathematical and physical meaning of the quasilinear analysis in the case alpha = 0 and of the connection between unsaturated and saturated flows. These papers assert that putting alpha = 0 in quasilinear solutions for the stream function gives solutions for saturated flows. In fact, putting alpha = 0 yields the precisely opposite case of purely capillary driven unsaturated flows. The argument of the papers is that for alpha = 0 the quasilinear equation for the stream function is reduced to Laplace's equation, which is obeyed by the stream function for saturated flows. The kinematics of all two-dimensional solenoidal irrotational flows is, however, such that their stream functions obey Laplace's equation, and the physical meaning, and indeed the physical existence, of any flow can be determined only from supplementary dynamic information about the velocity potential. (Baker-IVI)
W84-05336

WETTING FRONT ANALYSIS OF THE NONLINEAR DIFFUSION EQUATION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, I. G. Lisle, S. N. Prasad, and M. J. M. Romkens.
Water Resources Research, Vol. 20, No. 5, p 636-638, May, 1984. 1 Tab, 9 Ref.

Descriptors: *Wetting, *Mathematical equations, Nonlinear diffusion equation, Soil water, Perturbation, Sorption.

A perturbation procedure for the solution of the nonlinear diffusion equation is presented. The procedure yields water content as a function of the distance to the wetting front. The result is in agreement with earlier predictions of wetting front position and sorptivity using an optimal technique. The approach of Prasad and Romkens (Water Resour. Res., Vol. 18, p 1022-1028, 1982) is modified to apply to cases with rapidly increasing diffusivity near saturation. The main modification lies in the use of an integral expression in the series expansion around the wetting front. The solution yields the same result for the position of the wetting front and sorptivity as that obtained by optimization. The accuracy of the results is illustrated by comparison with an exact solution. (Baker-IVI)
W84-05337

ANALYTICAL RESULTS FOR PREDICTION OF VARIABLE RAINFALL INFILTRATION,
Colorado State Univ., Fort Collins. Engineering Research Center.
H. J. Morel-Seytoux.
Journal of Hydrology, Vol. 59, No. 3-4, p 209-230, November, 1982. 3 Fig, 8 Ref. National Science Foundation grant ENG-7924120.

Descriptors: *Soil water, *Infiltration, Unsaturated soils, Mathematical equations, Boundary conditions, Rainfall, Permeability, Ponding.

The basic equations that govern water movement in unsaturated soils are presented for a boundary condition of variable rainfall rate at the soil surface. In particular, a differential equation for the water content at the soil surface is derived. Solutions are then obtained for the time evolution of water content at the soil surface assuming a power law form for the relative permeability to water as a function of normalized water content. Ponding time formulae are obtained and compared with other previously published relations. Water content profiles are also obtained and their shapes are displayed graphically for the case of an exponent of 2 in the power law form of the relative permeability to water for a constant rainfall rate. Formulae are also derived for the situation of a variable rainfall pattern. A methodology for the coupling of the analytical procedures with an implicit numerical solution of the water content at the soil surface is suggested as a cost effective alternative to the strict numerical solution of the partial differential equation that governs the water content profile evolution. Postponding infiltration formulae and water content profile equations are also provided. The results of the study are well suited for incorporation in current watershed models. The approximations involved in the derivations are of little consequence as the essential nonlinear character of the equations was preserved and because the various parameters will in practice be calibrated on a series of historical observations. (Baker-IVI)
W84-05338

USE OF NATURAL TRACERS AS INDICATORS OF SOIL-WATER MOVEMENT IN A TEMPERATE SEMI-ARID REGION,
Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.
G. B. Allison, and M. W. Hughes.
Journal of Hydrology, Vol. 60, No. 1-4, p 157-173, January, 1983. 1 Tab, 8 Fig, 33 Ref.

Descriptors: *Soil water, *Drainage, Eucalyptus trees, Wheat, Semiarid lands, Australia, Roots, Evaporation, Chlorides.

A determination was made of the mechanism and amount of water moving through the soil beneath both native Eucalyptus scrub, known as mallee, and cleared, but cropped sites. The trees are characterized by an enlarged lignotuber beneath the soil surface from which several stems rise, giving the trees a coppiced appearance. The stems are branched sparingly and leaves occur only at the end of the branches. A change in land use from Eucalyptus scrub to wheat has caused considerable change in the mechanism of the movement of soil water and the amount of deep drainage. Chloride concentrations of soil water have been used to show the mean annual amount of deep drainage increases from less than 0.1 to about 3 mm/yr following clearing of the native vegetation. Chloride concentrations showed a peak in soil water of

about 11,000 g/cu m at a depth between 4 and 5 m beneath the cropped area. Beneath this depth concentrations fall slowly to about 9000 g/cu m at 12 m. The concentration of environmental tritium in soil water beneath the native vegetation is consistent with the theory that some relatively recent water (after 1960) has penetrated to depths of at least 12 m along channels occupied by living roots. Where the native vegetation has been cleared, no water which fell as rain since 1960 was found at depths greater than 2.5 m. Oxygen-18 and deuterium concentrations suggest that some water movement to the roots of the native vegetation is in the vapor phase. (Baker-IVI)
W84-05354

SCALED SPACE AND TIME VARIABLES IN SOIL-WATER AND GROUNDWATER FLUX-BOUNDARY PROBLEMS,
Rothamsted Experimental Station, Harpenden (England).Dept. of Physics.
E. G. Youngs.
Journal of Hydrology, Vol. 60, No. 1-4, p 303-309, January, 1983. 7 Ref.

Descriptors: *Soil water, *Diffusion coefficient, Diffusion, Absorption, Groundwater recharge, Wells, Groundwater.

Scaled space and time variables may be used in presenting in compact general form solutions of the diffusion equation with flux boundary conditions. Variables for use in soil-water and groundwater problems are given for flux-boundary conditions that are proportional to the time raised to some power, of which the constant flux-boundary condition is a particular case. In the general case of time-dependent surface fluxes, the scaling of variables is possible in certain circumstances. These scaled variables may be used in one-dimensional problems of soil-water absorption and of groundwater recharge, and also in radial problems, such as water movement to plant roots and of water abstraction by wells. (Baker-IVI)
W84-05363

OBJECTIVE ASSESSMENT OF SOIL-MOISTURE DEFICIT MODELS,
Institute of Hydrology, Wallingford (England).
I. R. Calder, R. J. Harding, and P. T. W. Rosier.
Journal of Hydrology, Vol. 60, No. 1-4, p 329-355, January, 1983. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Soil water, Model studies, Water stress, Grasslands, Mathematical equations, Evaporation, Rainfall, Spatial distribution, Transpiration.

The performance of different soil-moisture deficit models was assessed by comparing model predictions with over 3000 neutron-probe observations of soil moisture content at six grassland experimental sites. The models were formulated using combinations of different equations for estimating potential evaporation and different regulating functions relating actual to potential evaporation via the moisture status of the soil. The results indicate that more detailed potential evaporation equations do not necessarily result in improved soil moisture deficiency (SMD) predictions. Indeed the use of a simple climatological mean estimate of evaporation, which requires no measurement of the meteorological variables other than rainfall, when used in conjunction with a root constant regulating function produces marginally the best SMD predictions. The success of the climatological mean estimate at all sites and for all years clearly demonstrates the conservative nature of potential evaporation within the United Kingdom both spatially and temporally on an annual basis. However, a further mechanism is needed to contribute to this apparent conservatism by not allowing the grass transpiration to respond fully to variations in atmospheric demand. In addition to the SMD negative feedback mechanism which limits transpiration in times of high SMD, there is another, independent, negative feedback mechanism which limits transpiration in times of high atmospheric demand. Successive improvements to the soil aspects of the model by incorporating either a layer formulation or a root constant did result in significantly improved model fits. (Baker-IVI)
W84-05365

SOIL-WATER FLUX SENSOR AND ITS USE FOR FIELD STUDIES OF TRANSFER PROCESSES IN SURFACE SOIL,
Oita Univ. (Japan).
For primary bibliographic entry see Field 7B.
W84-05366

2H. Lakes

PROPORTION OF EMPNEUSTON AND TOTAL ATMOSPHERIC INPUTS OF CARBON, NITROGEN AND PHOSPHORUS IN THE NUTRIENT BUDGET OF A SMALL MESOTROPHIC LAKE (PIBURGER SEE, AUSTRIA),
Innsbruck Univ. (Austria). Inst. of Zoology.
R. Psenner.
Internationale Revue der Gesampten Hydrobioloie, Vol. 69, No. 1, p 23-39, 1984. 6 Fig, 6 Tab, 62 Ref.

Descriptors: *Empneuston, *Nitrogen, *Phosphorus, *Nutrient budget, *Mesotrophic lake, *Piburger, *Austria, Cycling nutrients, Nutrients, Organic carbon, Litter, Airborne detritus, Decomposition.

Litter and wet traps were employed to determine the inputs of coarse organic matter (empneuston), total organic carbon, total nitrogen and phosphorus through dry fallout and precipitation to a soft-water, mesotrophic lake. The dispersal of airborne material over the lake surface was investigated, and a method for the calculation of total input was developed. The component of the particulate matter larger than 1 mm contained the largest proportion of organic carbon, while the dissolved and the fine particle (smaller than 1 mm) fractions made greater contributions to the inputs of nitrogen and phosphorus compounds. The importance of the large particle fraction of the airborne organic matter in the lake's nutrient budget during the autumnal fall of litter was confirmed. The maximum total airborne input seems to occur during spring and summer. The input of phosphorus compounds through the atmosphere to small forest lakes is large compared to that from other sources. Airborne material accounts for 39% of the total phosphorus loading. (Murphy-IVI)
W84-04893

PRIMARY PRODUCTION CHARACTERISTICS OF A HIMALAYAN LAKE IN KASHMIR,
Kashmir Univ., Srinagar (India). Centre of Research for Development.
A. Wanganeo.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 1, p 79-90, 1984. 4 Fig, 7 Tab, 23 Ref.

Descriptors: *Primary productivity, *Lake Manasbal, *Kashmir, Nannoplankton, Thermal stratification, Seasonal variation, Phytoplankton, Bicarbonates, Calcium, Nutrients.

Lake Manasbal is the only valley lake in the region studied with a true thermal stratification during the summer season. The lake is situated in the Kashmir Himalayan Region at about 1584 m.s.l. at 34 degrees 15 min N, 74 degrees 40 min E. The lake water is alkaline and well buffered. Calcium is the predominant cation, and bicarbonate is the predominant anion. The production was dependent on the quantity of nutrients supplied. The carbon fixation rate has increased during the years 1971 to 1979. The fixation recorded ranged from between 17.2 mgC/sq m/day and 1281.21 mg C/sq m/day. The overall production pattern was bimodal, with a minor peak in spring (719.3 mg C/sq m/day) and a major one in summer (1496.2 mg C/sq m/day. The nannoplankton was responsible for most of the carbon fixation (69%), and the lake was classified as low productive in comparison to other lakes in the region. (Baker-IVI)
W84-04895

ABUNDANCE AND COMMUNITY STRUCTURE OF LIMNETIC ZOOPLANKTERS IN KUMAUN LAKES, INDIA,
D.S.B. Constituent Coll., Naini Tal (India). Dept. of Zoology.
P. C. Sharma, and M. C. Pant.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 1, p 91-109, 1984. 12 Fig, 3 Tab, 72 Ref.

Descriptors: *Zooplankton, *Primary productivity, *Lake Nainital, *Lake Bhimtal, *India, Eutrophication, Seasonal variation, Thermal stratification.

The zooplankton compositions in the limnetic zones of two subtropical lakes, the Nainital and the Bhimtal, India, were more or less similar in terms of species composition. Numerically, zooplankters were abundant during the thermal stratification (summer-autumn) period and scarce during the over-turn (winter). The density of the zooplankton population reported from the eutrophic Lake Nainital was higher than in the aligotrophic Lake Bhimtal. A bimodal pattern in the zooplankton abundance was recorded for Lake Bhimtal, whereas a third peak was also observed along with two peaks in Lake Nainital. Among the three groups studied copepods dominated over cladocerans and rotifers in both the lakes. The low species diversity and the absence of Daphnia sp. (a dominant zooplankter in Lake Bhimtal) in Lake Nainital probably indicates the advanced stage of eutrophication in lake Bhimtal. The Shannon Weaver diversity was higher for Lake Bhimtal than for Lake Nainital. (Baker-IVI)
W84-04896

INFLUENCE OF NATURAL ORGANIC MATTER ON THE ADSORPTION PROPERTIES OF MINERAL PARTICLES IN LAKE WATER,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
P. Baccini, E. Grieder, R. Stierli, and S. Goldberg.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 1, p 99-116, 1982. 9 Fig, 11 Tab, 20 Ref.

Descriptors: *Lakes, *Minerals, *Adsorption, *Organic matter, *Lake Alpnach, *Switzerland, Copper, Zinc, Hydrogen phosphate, Lake sediments.

The absorption characteristics of a well defined mineral particle, gamma-aluminum oxide, and a natural particle, Bg, isolated from the sediment surface of Lake Alpnach, were studied under lake water conditions. A method was developed to measure adsorbed organic matter as organic carbon on mineral particles, which were suspended at low concentrations in filtered lake water or in an electroyte solution of .002 M NaHCO3. At pH 8, and particle concentrations between 2 and 16 mg/l, natural organic matter (NOM) in the system reduced significantly the adsorption of copper, zinc, and hydrogen phosphate ions. Model calculations support the hypothesis that NOM can saturate the binding sites of the mineral surface at low particle concentrations preventing other ions from being adsorbed. The observed differences between copper and zinc adsorption can be explained by the differences in speciation due to NOM. The results of the experiments can also explain the findings that in prealpine lakes allochthonous particles are not very efficient scavengers while passing through the lacustrine water column. (Baker-IVI)
W84-04904

ICE COVER AND HYPOLIMNETIC REOXYGENATION IN THE GREIFENSEE FROM 1950 TO 1980 (EISBEDECKUNG UND HYPOLIMNISCHE SAUERSTOFFANREICHERUNG IM GREIFENSEE VON 1950 BIS 1980),
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
E. A. Thomas, and C. G. Orn.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 1, p 117-148, 1982. 11 Fig, 4 Tab, 11 Ref.

Descriptors: *Ice cover, *Wind, *Switzerland, *Greifensee, *Oxygenation, Oxygen deficit, Hypolimnion, Dissolved oxygen, Lakes.

From 1949 to 1980 the Greifensee was completely ice-covered for an estimated duration of 481 days. The longest period of ice cover, 82 days, occurred in 1963. During all periods of ice cover a total wind distance travelled by winds greater than 10 km/hr of 12,702 km was recorded at the nearby meteorological station Zurich SMA. The strong empirical relationships found between wind and hypolimnetic oxygen content in years with and without ice cover are schematized. When ice cover strongly limits wind action on the lake surface, the absolute oxygen deficit at the end of the preceding summer stratification will only be partly compensated in the following cold half-year. In 2 of the 13 years with ice cover, autumnal cooling was normal, but as fast heating, coupled with poor wind action, prevented any net oxygen increase following the breakup of the coat of ice, the annual oxygen maximum was found abnormally early, in January, prior to the ice cover. Disastrous oxygen conditions result if unfavorable mixing during autumnal cooling is followed by an early ice cover of long duration, succeeded by rapid initial summer heat uptake. This was the case in the worst oxygen year, 1971, when the hypolimnetic oxygen content in April amounted to only 20% of the April content in the best oxygen year, 1950. It is estimated that the loss of anemogenic oxygen increase caused by ice in the 121 years with ice winds to be 986 t or less than 4% of the total oxygen increase in all 30 years investigated. However, more than half of this hypothetical loss resulted in two years only, 1963 and 1971, the effect in these two years being an abnormaly early depletion of hypolimnetic oxygen reserves. The study underlines the necessity of a consistent registration of time and duration of ice cover on lakes. (Baker-IVI)
W84-04905

BACTERIAL DECAY OF THE AUTUMNAL PHYTOPLANKTON IN LAKE CONSTANCE (BODENSEE),
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. Simon, and M. M. Tilzer.
Schweizerische Zeitschrift fur Hydrologie, Vol 44, No 2, p 263-275, 1982. 5 Fig, 35 Ref.

Descriptors: *Phytoplankton, *Lake Constance, Bacteria, Seston, Bacteria, Biomass, Chlorophyll, Pheopigments, Particulates, Organic carbon, Detritus, Decomposition.

The breakdown of autumnal phytoplankton was studied in Lake Constance by combining chemical seston analyses, bacterial counts and scanning electron microscopy. Phytoplankton biomass reached a maximum in October with euphotic chlorophyll a concentrations of 8 mg/cu m. During November, phytoplankton biomass decreased leading to chlorophyll a concentrations of below 2 mg/cubic m. When phytoplankton biomass was high pheopigments comprised about 40% of total pigment concentration within the euphotic zone. Below 20 m depth pheopigments were usually in excess of chlorophyll a. High phytoplankton biomass was associated with small numbers of bacteria. Total particulate organic carbon exceeded biomass carbon by a factor of 4-10. Detrital aggregates were colonized by bacteria to varying degrees. Small particles near the lake surface were colonized by small rods and cocci. The degradation of algal detritus occurs in two steps. First, easily degradable dissolved material is released by dying cells and serves as a substrate for free-living bacteria. In a second stage bacterial colonization and degradation of particulate organic material occurs. On a vertical scale the final stage of decay of detritus is characterized by minimal bacterial attachment. It is likely that the remains of detrital particles consist of highly refractory material that cannot be used by bacteria any further. Chemically inert particles show some bacterial attachment. During the vegetation period, particles serve both as nutrient source and attachment matrix. During winter, by contrast, inert particles dominate that merely serve as attachment sites with only negligible nutritive value. (Baker-IVI)
W84-04914

CLADOCERA REMAINS IN RECENT SEDIMENTS AS INDICES OF CULTURAL EUTROPHICATION OF LAKE COMO,
Milan Univ. (Italy). Lab. di Limnologia.
G. Parise, and A. Riva.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 277-287, 7 Fig, 1 Tab, 30 Ref.

Descriptors: *Eutrophication, *Lake Como, *Italy, *Cladocera, Organic matter, Nitrogen, Chlorophyll, Daphnia, Acroperus, Nutrients, Lake sediments, Urbanization, Agriculture, Industrial wastes, Environmental effects.

Cladocera remains, organic matter, nitrogen, chlorophyll derivatives have been examined in the sediments to follow the trophic evolution of Lake Como. Four sediment cores were taken from the deepest (410 m) Italian lake at four stations and analyzed. The aim was to follow the productivity increase of Lake Como induced by the agricultural, urban and industrial development in the drainage basin. The most abundant Cladocera found are Bosmina sp., Daphnia sp., Chydorus sphaericus, Sida crystallina, Acroperus harpae, Leptodaro kindtii, Alona affinis. The most superficial portions of sediment reflect the remarkable biological and chemical changes in the water body in the last years. In the southern basins the frequency of Bosmina remains registers a high increase while Daphnia and Chydorus decrease progressively. Sida and Acroperus seem to disappear from these basins in a period included between 1960 and 1970. In the northern basins the increase of Bosmina, Daphnia, Chydorus and Acroperus remains is observed, while Sida registers an increase at Spartivento and is absent at Oligiasaca. Organic matter, nitrogen, chlorophyll derivatives register in the four stations considerable increases more remarkable in the two southern basins. The general increase noted in trophic stage is more remarkable in the southern basins, heavily influenced by the activities of the towns of Como and Lecco, than in the less densely populated northern basins. (Baker-IVI)
W84-04915

ANALYSIS AND CHARACTERIZATION OF NATURAL ORGANIC MATTERS IN FRESHWATERS II. COMPARISON OF THE PROPERTIES OF WATERS OF VARIOUS ORIGINS AND THEIR ANNUAL TREND,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle, and P. Deladoey.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 363-391, 1982. 18 Fig, 6 Tab, 25 Ref.

Descriptors: *Organic matter, *Water properties, Physical properties, Hydrologic cycle, Flocculation, Ions, Inorganic compounds.

A comparison is done between the properties of organic matters of a series of natural waters, of water extracts of soils and of products of in vitro decomposition of leaves. The properties of 'soluble' (< 0.2 micro m) organic matters of freshwaters are compared on the basis of their spectrometric properties (fluorescence and UV absorption), their complexation capabilities for Cu(II), their adsorption ability on kaolinite and their size (ultrafiltration). These parameters were studied for a series of various waters and their annual trends were measured. Correlations between the parameters related to organic matters and the concentrations of inorganic ions (particularly Fe, Al, Si, Ca) or pH were also examined. The results indicate that spectrometric parameters are mainly a measure of fulvic compounds of the water masses, whose origin is mostly the leaching of the surrounding lands. These compounds may be separated from other types of organic matters, from Si(IV) and Ca(2+) and from a large portion of Fe by ultrafiltration fractionation. Elimination of fulvic compounds from water masses could occur by means of adsorption on solid silicate or CaCO3, but flocculation does not seem to play an important role. Their complexing ability is large. (Murphy-IVI)
W84-04917

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 2; IN SITU DETERMINATION OF THE EQUILIBRIA H2CO3 EQUILIBRIUM HCO3(-) + H(+) IN THE TEMPERATURE RANGE 4-18 DEGREES C IN A LAKE WATER OF 1.6 MM IONIC STRENGTH,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
J. Liden.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 393-404, 1982. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Lakes, *Chemical properties, *Equilibrium constant, *Carbonic acid, Bicarbonates, Acidity, Carbonic acid, Natural waters, Hydrogen ion concentration.

The apparent equilibrium constant for the first acidity constant of carbonic acid has been determined in a lake water of 1.6 mM ionic strength in the temperature interval 4-19 degrees C. The experimental method used comprises pH measurements in situ with a probe and an IR-method for the selective determination of bicarbonate and carbonate ions in water samples. Because the in situ determination of an equilibrium constant in a natural water is a new approach, the different experimental conditions must be carefully considered. The quantitative calculation based on in situ equilibrium parameters can be justified. It appears that the use of a pH scale based on concentrations would facilitate the use of equilibrium constants in natural waters. (Baker-IVI)
W84-04918

SURFACE SEICHES OF LAKE OF ZURICH,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
K. Hutter, G. Raggi ɔ, C. Bucher, and G. Salvade.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 423-454, 1982. 16 Fig, 3 Tab, 42 Ref.

Descriptors: *Seiches, *Lake of Zurich, Surface water, Hydrologic models, Mathematical models, Physical properties, Switzerland.

A computational analysis of the periods and structure of surface seiches of Lake of Zurich and its experimental verification from three simultaneous water gauge recordings, mounted along the shores in Zurich, Pfaffikon and Rapperswil is given. After a brief historical account the governing equations and the procedure, how they were discretized by a finite element technique are introduced. Computational results concern seiche periods and seiche structure, in particular co-range and co-tidal lines for the first seven free oscillations which are discussed in detail. Experimental verification is from recordings taken during January 1982. Inspection by eye allows identification of the three lowest order seiche periods including the phase shift between the recordings of Zurich and Rapperswil. Higher order modes (up to order 19) are also detected by this method. Power spectral analysis including interstation phase shift and coherence allow identification of over fifteen seiche periods. Agreement between the theoretically predicted and experimentally determined periods is excellent for the first, second, third, fair for the fourth, fifth and sixth mode and good for the other higher modes, but statistical reliability is low for these. (Author's abstract)
W84-04920

SURFACE SEICHES OF LAKE OF LUGANO,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
K. Hutter, G. Raggio, C. Bucher, G. Salvade, and F. Zamboni.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 455-484, 1982. 22 Fig, 6 Tab, 15 Ref.

Descriptors: *Seiches, *Lake of Lugano, Graphical analysis, Surface seiches, Spectral analysis, Lake morphometry, Hydrologic aspects, Hydrologic data, Hydrologic properties, Hydrologic maps.

A computational analysis of the periods and structure of surface seiches of the southern basin of Lake of Lugano and its experimental verification from three simultaneous water gauge recordings, mounted along the shores of Agno, Morcote and Riva S. Vitale, is given. The first five theoretical modes are calculated with a finite element code of the tidal equations; it yields the eigenperiods and co-range and co-tidal lines, which are graphically displayed and discussed in detail. Experimental verification is from recordings taken during February/March 1982. Inspection by eye allows identification of the five lowest order modes, partly interstation phase shift. Power spectral analysis of three-times series and interstation phase difference and coherence spectra allow identification of higher order modes, probably up to order 13. Agreement between the theoretically predicted and the experimentally determined periods is excellent for all calculated modes. Computational results for the four lowest modes and their structure of the northern basin of Lake of Lugano are also presented and experimentally verified with records taken from an event in August 1979. Agreement is again excellent. (Author's abstract)
W84-04921

PHYSICAL, CHEMICAL, AND BIOLOGICAL CHARACTERIZATION OF TWO NATURAL HABITATS OF TUBIFICIDAE: ENVIRONMENTAL ADAPTATIONS IN THE ENERGY METABOLISM OF THE WORMS (PHYSIKALISCHE, CHEMISCHE UND BIOLOGISCHE CHARAKTERISIERUNG ZWEIER TUBIFICIDEN-STANDORTE: ANPASSUNGEN IM ENERGIESTOFFWECHSEL DER WURMER AN DIE NATURLICHEN LEBENSBEDINGUNGEN),
Ulm Univ. (Germany, F.R.). Abt. Allgemeine Zoologie (Biologie II).
J. Seuss, E. Hipp, A. Hohenberger, and K. H. Hoffmann.
Archiv fur Hydrobiologie, Vol. 100, No. 1, p 45-59, April, 1984. 5 Fig, 2 Tab, 36 Ref.

Descriptors: *Tubificids, *Eutrophication, *Pond, *Brook, Dissolved oxygen, Oligochaetes, Seasonal variation, Tubifex, Phosphorus, Iron, Manganese, Ammonia, Sediments, Metabolism, Organic matter, Stratification.

Changes in physical and chemical composition during the course of a year were determined for surface and sediment water of an eutrophic pond and a brook in the area of Ulm/Donau (West Germany) for a characterization of two natural habitats of tubificids. The pond is characterized as highly eutrophic on the basis of its stratification for ammonia-N, phosphorus, iron, and manganese from the surface water to the sediment water. It exhibits a considerable oxygen deficiency twice a year. The brook also demonstrates eutrophication, but the dissolved oxygen content is not below 75% saturation. The low number of Tubifex tubifex and the additional reduction in total number of oligochaetes from autumn to spring are probably caused by the low tolerance of the worms to long-term anoxia under natural conditions. The energy metabolism of T. tubifex is optimally adapted to short-term fluctuations in oxygen content as well as to an enrichment of the sediment organic material (low molecular weight organic acids). (Moore-IVI)
W84-05003

SURVEY OF SODIUM AND CHLORIDE CONCENTRATIONS IN FLORIDA LAKES,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr.
Florida Scientist, Vol. 47, No. 1, p 44-45, Winter, 1984. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Lakes, *Sodium, *Chloride, *Florida, Chemical analysis, Minerals, Saline water intrusion, Coastal waters, Lagoons, Salt springs.

A survey of 165 lakes located in different geologic and physiographic regions was conducted to determine sodium and chloride concentrations. Sodium concentrations in the lakes ranged from 1.2 to 1200 mg/l and chloride concentrations ranged from 1.7 to 2300 mg/l. While there was considerable variabiliy in lake concentrations, analysis of the data indicates that there are distinct regional differences. A general increase in sodium and chloride concentrations occurs as one moves from northwest to southeast Florida. Lakes located on ridges such as the Mount Dora Ridge, the Deland Ridge, and the Lake Wales Ridge generally have lower concentrations than lakes located in the surrounding lowlands. Lakes of the middle and lower St. Johns River have high concentrations because of inputs of mineralized water derived from marine sediments and salt springs. Coastal lakes, especially coastal lagoon lakes like Western Lake have higher concentrations than inland lakes because of salt water intrusion. (Baker-IVI)
W84-05011

BAG EXPERIMENTS ON THE EFFECT OF PHOSPHORUS AND BASE ADDITIONS ON THE ALGAL BIOMASS AND SPECIES COMPOSITION OF AN ACID LAKE,
West Virginia Univ., Morgantown. Dept. of Biology.
For primary bibliographic entry see Field 5G.
W84-05013

PRODUCTION AND DISTRIBUTION OF THE MICROPHYTOBENTHOS IN THE SEDIMENT OF LAKE MIKOLAJSKIE,
Rostock Univ. (German, D.R.). Dept. of Biology.
N. Wasmund.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 2, p 215-229, 1984. 6 Fig, 5 Tab, 47 Ref.

Descriptors: *Algae, *Benthos, *Lake sediments, *Lake Mikolajskie, *Poland, Primary productivity, Distribution, Chlorophyll, Algal growth, Chlorophyll a, Littoral zone, Biomass.

Lake Mikolajskie is a eutrophic lake in the Mazurian lakes are of northeast Poland. Four stations in the shallow littoral zone of Lake Mikolajskie were investigated in regard to in situ primary production, pigment concentration and algal biomass in the sediment during the autumn of 1980. The sampling technique developed permitted the selection of different sediment strata and their transfer to the exposure vessels for production measurements. Gross production potential, chlorophyll a concentration and live algal biomass decreased with increasing sediment depth. The minima in chlorophyll a concentration and algal biomass often found at the sediment surface may be caused by removal of algae due to wave action or active diurnal migration of the algae. Only an intimation of a downward migration during the morning was noted, but the importance of wave action for the magnitude of the microalgal population is shown particularly clearly by comparison of the four stations, which differed substantially in their degrees of exposure. Phytoplankton primary production measurements performed at the same time showed that the microphytobenthos may be the most important producer in the shallow littoral zone. (Baker-IVI)
W84-05015

HOW CURRENTS ON DIFFERENT SIDES OF SUBSTRATES IN STREAMS AFFECT MECHANISMS OF BENTHIC ALGAL ACCUMULATION,
Michigan Univ., Ann Arbor. School of Natural Resources.
R. J. Stevenson.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 2, p 241-262, 1984. 11 Fig, 3 Tab, 53 Ref.

Descriptors: *Stream currents, *Diatoms, *Benthos, Eddies, Water currents, Species diversity, Reproduction, Colonization, Immigration, Aquatic habitats.

Benthic diatom accumulation rates and diversity were monitored for 32 days in five habitats where current conditions were different. After 32 days, diatom abundance in a sheltered habitat where eddies occurred over substrates was over eight times the abundance in a habitat that was exposed directly to the main flow of the stream (about 30 cm/sec). Diatom immigration rates and species richness of diatom taxocenes were negatively related to exposure; whereas, diatom reproduction rates, death rates and relative abundances of the eight dominant diatom species were not related to the small differences in current velocity that occurred. During the 32-day colonization period diatom immigration rates increased, species richness of diatom taxocenes increased and evenness of species abundances decreased. Species composition of diatom taxocenes shifted from a numerical dominance by fast immigrators to dominance by fast reproducers during the 32-day colonization. (Author's abstract)
W84-05016

EFFECTS OF CHRONIC TURBIDITY ON DENSITY AND GROWTH OF STEELHEADS AND COHO SALMON,
Idaho Cooperative Fishery Research Unit, Moscow.
J. W. Sigler, T. C. Bjornn, and F. H. Everest.
Transactions of the American Fisheries Society, Vol. 113, No. 2, p 142-150, March, 1984. 4 Fig, 4 Tab, 10 Ref.

Descriptors: *Fish behavior, *Turbidity, *Salmon, *Trout, Turbid water, Lakes, Rivers, Channels, Growth.

In general, more fish stayed in channels with clear water than with turbid water, and weight and length of both steelheads and coho salmon increased faster in clear water. In most tests there was a significant difference in growth rates between fish in clear versus turbid water. Fish reared in clear water were not always significantly larger than fish in turbid water, but were growing at faster rates. After longer periods of growth, greater divergence of weight and length between fish in clear versus turbid water presumably would have occurred. Densities of fish in the clear water channels, although not always statistically different, were consistently higher than those in the turbid water. Larger numbers of fish emigrated from the channel with turbid water than from the one with clear water during the first two diel cycles in each test, indicating the turbidity was stressful to the fish. Some fish that left the turbid water still had a portion of yolk sac left, indicating that inability to obtain sufficient food was not the principal reason for leaving. (Baker-IVI)
W84-05084

GROWTH CHARACTERISTICS OF AQUATIC MACROPHYTES CULTURED IN NUTRIENT-ENRICHED WATER: I. WATER HYACINTH, WATER LETTUCE, AND PENNYWORT,
Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and W. F. DeBusk.
Economic Botany, Vol. 38, No. 2, p 229-239, April-June, 1984. 6 Fig, 4 Tab, 15 Ref.

Descriptors: *Aquatic plants, *Plant growth, *Macrophytes, *Florida, Biomass, Seasonal variation, Nutrients, Water hyacinth, Water lettuce, Pennywort.

Seasonal growth characteristics and biomass yield potential of 3 floating aquatic macrophytes cultured in nutrient nonlimiting conditions were evaluated in central Florida's climatic conditions. Growth cycle (growth curve) of the plants was found to be complete when maximum plant density was reached and no additional increase in growth was recorded. Biomass yield per unit area and time was found to be maximum in the linear phase of the growth curve; plant density in this phase was defined as 'operational plant density,' a density range in which a biomass production system is operated to obtain the highest possible yields. Biomass yields were found to be 106, 72, and 41 t (dry wt)/ha/yr, respectively, for water hyacinth (Eichhornia crassipes), water lettuce (Pistia stratiotes), and pennywort (Hydrocotyle umbellata). Operational plant density was found to be in the range of 500-2,000 g dry wt/sq m for water hyacinth,

200-700 g dry wt/sq m for water lettuce, and 250-650 g dry wt/sq m for pennywort. Seasonality was observed in growth rates but not in operational plant density. Specific growth rate (% increase per day) was found to maximum at low plant densities and decreased as the plant density increased. Results show that water hyacinth and water lettuce can be successfully grown for a period of about 10 mo, while pennywort, a cool season plant, can be integrated into water hyacinth/water lettuce biomass production system to obtain high yields in the winter. (Author's abstract)
W84-05096

APPLICATION OF A SIMPLE NUMERICAL WAVE PREDICTION MODEL TO LAKE ERIE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. J. Schwab, J. R. Bennett, P. C. Lu, and M. A. Donelan.
Journal of Geophysical Research, Vol. 89, No. C3, p 3586-3592, May, 1984. 9 Fig, 2 Tab, 24 Ref.

Descriptors: *Lake Erie, *Waves, *Prediction, Mathematical models, Wave height, Wave period, Wave direction, Wind.

A parametric dynamical wave prediction model has been adapted and tested against semianalytic empirical results for steady conditions in a circular basin and extensive field measurements of wave height, period, and direction. The adapted numerical model accurately predicts the directional spreading of waves for uniform steady wind that Donelan (1980) had predicted analytically for fetch-limited waves. When the model was applied to the central basin of Lake Erie and the results compared to observations of wave height and period (at two points in the lake) and direction (at one point), results for wave height and direction estimates were excellent compared to measurements at a research tower off the southern shore, but computed wave heights were lower than observed at a weather buoy in the western part. The model somewhat underestimated wave periods at both places. Thus, with locally measured wind data as input, the model estimates wave height and direction well and wave period acceptably. (Author's abstract)
W84-05110

EFFECTS OF AERATION AND TEMPERATURE ON NUTRIENT REGENERATION FROM SELECTED AQUATIC MACROPHYTES,
Agricultural Research and Education Center, Sanford, FL.
R. A. Ogwada, K. R. Reddy, and D. A. Graetz.
Journal of Environmental Quality, Vol. 13, No. 2, p 239-243, April-June, 1984. 10 Fig, 1 Tab, 24 Ref.

Descriptors: *Aeration, *Temperature effects, *Nutrients, *Decomposition, Aquatic plants, Macrophytes, Nitrogen, Phosphorus, Eutrophic lakes, Waterhyacinth, Pennywort, Hydrilla, Cattails, Aerobic conditions, Anaerobic conditions.

In an aquatic system, macrophyte die-off may occur as a result of plant maturity, freeze damage, or herbicide damage. Batch incubation was used to investigate the effect of aeration and temperature on the N and P release by decomposing aquatic macrophytes in eutrophic lake water. Nutrient release by waterhyacinth (Eichhornia crassipes) pennywort (Hydrocotyle umbellata), hydrilla (Hydrilla verticillata), and cattails (Typha latifolia) was evaluated under aerobic conditions. Waterhyacinth plants tagged with N-15 were used to determine the N-15 release at varying temperature levels and under anaerobic (oxygen free) and low-dissolved O2 (open system where the only O2 source was diffusion through the overlying water) conditions. Nutrient release was found to be rapid initially due to solubilization, followed by slow nutrient release as a result of microbial decomposition. Under aerobic conditions, NO3(-) formation in the water was significantly related to C/N ratio of the plants. About 48 to 76% of the plant N and 67 to 90% of the plant P were released at the end of 105 d of aerobic decomposition. After 94 d, about 86 and 88% of N-15 was released from the plant tissue under anaerobic and low-dissolved O2 conditions, respectively. Nutrient release is dependent on the water temperature, indicating that N and P release from plant tissue will be slower in winter than in summer months. (Moore-IVI)
W84-05117

FUNCTIONAL PROPERTIES OF A MICROCOSM OF THE FRESHWATER BENTHIC ZONE AND THE EFFECTS OF 2,4-DICHLOROPHENOL,
Argonne National Lab., IL. Radiological and Environmental Research Div.
For primary bibliographic entry see Field 5C.
W84-05188

SPATIO-TEMPORAL VARIATION OF THE LITTORAL MACROBENTHIC COMMUNITY STRUCTURE IN A COLD CLIMATE (VARIATIONS SPATIALES ET SAISONNIERES DE LA STRUCTURE DE GROUPEMENTS MACROBENTHIQUES LITTORAUX EN CLIMAT FROID),
Quebec Univ., Trois-Rivieres. Groupe de Recherche sur les Ecosystemes Aquatiques.
B. Vincent.
Hydrobiologia, Vol. 102, No. 3, p 175-186, June, 1983. 6 Fig, 7 Tab, 35 Ref.

Descriptors: *Saint-Lawrence River, *Quebec, *Ecosystems, *Spatial variation, *Temporal variation, *Benthos, Seasonal variations, Icefoot, Ice cover, Species diversity, Benthic flora, Benthic fauna, Gastropods, Chironomids.

Spatio-temporal variations of macrobenthic community structure were studied in the littoral zone of the Saint-Lawrence River (Quebec). Its thermal regime is characterized by steep seasonal gradients from April to November and by a long ice-cover period with formation of an icefoot. Six sites were sampled each season for one year. Temporal variations are less important than spatial variations. They are mainly seasonal and depend on emergence and recruitment periods and on migrations but there are also long-term variations. An increase of the mean diversity index of sites corresponds to an increase of seasonal variations of community profile and to a decrease of seasonal variations of organism abundance; it is explained by a better exploitation of benthic resources rather than by environment stability. Spatial variations of community structure depend mainly on vegetation abundance. There is no faunal zonation corresponding to the icefoot action. In sites where Gastropods are abundant, icefoot does not change community profile but it explains diminutions of density and of species diversity. Chironomids are little affected by this phenomenon. (Author's abstract)
W84-05202

TWO DIFFERENT METHODS OF EVALUATING NUTRIENT LIMITATIONS OF PERIPHYTON BIOASSAYS, USING WATER FROM THE RIVER RHINE AND EIGHT OF ITS TRIBUTARIES,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
F. Schanz, and H. Juon.
Hydrobiologia, Vol. 102, No. 3, p 187-195, June, 1983. 5 Fig, 5 Tab, 25 Ref. Swiss National Science Foundation grant 3.075.76.

Descriptors: *Limiting nutrients, *Periphyton, *Rhine River, Water quality, Nitrogen, Phosphorus, Algal growth potential, Bioassay, Nitrates, Nitrites, Ammonia, Phosphates.

A graphical method and a calculative method are tested for determining the limiting nutrients in bioassays using values of selected chemical properties and results of biotests carried out with microperiphyton (a mixture of several algal species, not axenic). The data used were obtained from the River Rhine (two stations) and eight of its tributaries in 1978 and 1979. Determinations of the following inorganic substances were made: PO4(3-)-P; NO3(-)-N; NO2(-)-N; NH4(+)-N and Cl(-). In addition, pH and carbonate alkalinity were measured. Bioassays to obtain the algal growth potential (AGP) were carried out using periphyton from the River Rhine. A linear relationship could be established between NO3(-)-N and the AGP, while the AGP showed a non-linear dependence on the PO4(3-)-P concentration. The critical N/P ratio for N or P limitation of the algal growth in bioassays was evaluated graphically and by calculation. The results of the two methods are in good agreement: N is the limiting factor at NO3(-)-N/PO4(3-)-P ratios less than 10, while P is limiting at ratios greater than 20. At values between 10 and 20 neither N nor P can be supposed with certainty to be limiting. Either of the two methods may be used to determine whether nitrogen or phosphorus is the probable factor limiting algal growth. An accurate determination of the limiting factor is only possible following experiments where the nutrients are added prior to the beginning of the test, a procedure which is not always practicable when analyzing water quality. (Moore-IVI)
W84-05203

EFFECTS OF ARTIFICIAL DESTRATIFICATION ON ZOOBENTHOS AND ON THE TROPHIC STATUS OF A POLISH RESERVOIR,
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Inst. of Hydrobiolgy and Water Conservation.
S. Wielgosz.
Hydrobiologia, Vol. 102, No. 3, p 197-23, June, 1983. 4 Tab, 28 Ref.

Descriptors: *Reservoirs, *Benthos, *Destratification, *Trophic status, *Poland, *Lake Mutek, Stratification, Eutrophication, Zoobenthos, Littoral zone, Fauna.

The macrobenthic fauna, especially the Chironomidae, and the sequence of faunal groups in a horizontal transect across Lake Mutek were studied before and after artificial destratification. Prior to destratification, Chironomidae dominated in the littoral, constituting 45.1% of numbers, and 54.5% of biomass, and ranking before Oligochaeta. The following frequency of chironomids was observed: Cladopelma viridula (8.03%), Polypedilum nubeculosum (7/.4%), and Chironomus plumosus (6.44%). During destratification in 1979, there was a 3-fold increase in zoobenthos abundance and a 1.5-fold increase in biomass. Changes took place in the dominance order of chironomid species. An increase in the abundance of the littoral zoocenosis was connected with increasing trophy in the zone. There was a 6-fold increase in the density of Oligochaeta, a 3-fold increase of Chironomidae and a 20-fold reduction in Chaoborus flavicans in the sublittoral. Chironomus plumosus and Tanypus kraatzi were dominant among the Chironomidae. The greatest changes were observed in the communities of the pelagial. In the 1977-1979 period, Lake Mutek belonged to the Chaoborus Lake type - that is it was polytrophic with restricted mixis. During re-aeration Lake Mutek changed into a eutrophic lake. (Baker-IVI)
W84-05204

SAYNAJALAMPI AND THE DIFFICULTIES INHERENT IN THE DATING OF SEDIMENTS IN A HARD-WATER LAKE,
Uppsala Univ. (Sweden). Fysiska Institutionen.
I. U. Olsson, F. El-Daoushy, and Y. Vasari.
Hydrobiologia, Vol. 103, p 5-14, July, 1983. 8 Fig, 1 Tab, 41 Ref.

Descriptors: *Paleolimnology, *Saynajalampi, *Finland, *Radioisotope dating, Limnology, Carbon radioisotopes, Polonium, Radium, Lead radioisotopes, Drainage effects, Hard water, Lake sediments, Submerged plants.

Saynajalampi is a small lake in the northern part of Kuusamo, Finland. The immediate vicinity of the lake comprises land which was previouly rich fen but has now been mostly cleared and reclaimed for agriculture. Previous measurements of the C-14 activity of lake sediments from Saynajalampi indicated a severe hard-water effect. Samples from cores, collected in 1977, were sliced into thin sec-

tions down to 18 cm. Light-colored layers, apparently due to catchment drainage, were used together with density diagrams to correlate the cores. The drainage history gives a time-scale showing that the lowest samples dated were just old enough to be pre-bomb sediments. Three samples of submerged plants were also examined, indicating some exchange with the air and an appreciable reservoir age. The activity of the plants was significantly lower in 1978 than in 1970. One sample, well below the lowest drainage stratum, indicates a reservoir age of ca. 1100 years. This sample yielded an apparent age of the insoluble (INS) fraction which was significantly different from that of the soluble (SOL) fraction. The SOL fraction appears younger than the INS fraction. The difference was determined to ca. 600 years. Total Pb-210 was determined via Po-210 using isotope dilution while Ra-226 was measured with the help of radon emanation. The Ra-226 was used to estimate the supported Pb-210. The unsupported Pb-210 showed a higher sediment accumulation rate for the top nine cm of one core (the length investigated was 16.5 cm). The varying accumulation rate was explained by human activities, as could be seen from the heterogenous sediment composition of the cores. Pollen analysis does not give any reliable indication of agriculture. The apparent C-14 age of the sediment is due partly to old bicarbonate and in situ contamination. When erosion occurs because of drainage old organic material is also introduced. (Moore-IVI)
W84-05205

USE OF FALLOUT 137CS AND 239,240PU FOR DATING OF LAKE SEDIMENTS,
Helsinki Univ. (Finland). Dept. of Radiochemistry.
T. Jaakkola, K. Tolonen, P. Huttunen, and S. Leskinen.
Hydrobiologia, Vol. 103, p 15-19, July, 1983. 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Lake sediments, *Dating, *Cesium radioisotopes, *Plutonium radioisotopes, Finland, Laukunpampi, Lovojarvi, Paajarvi, Varves, Fallout.

The distribution of Cs-137 and Pu-239,240 in sediment core samples of the Finnish lakes Laukunlampi, Lovojarvi and Paajarvi were determined. The sediment samples were collected using dry ice and liquid nitrogen freezing methods. The sediments of these lakes are annually laminated. A clear maximum concentration of Cs-137 and Pu-239,240 was found in sediment layers formed during 1962-1964, the years of maximum fallout, and the middle of the 1950's can be estimated from the Cs-137 and Pu-239,240 profiles. The highest concentrations, 11,500 and 820 pCi/kg dry wt for Cs-137 and Pu-239,240, respectively, were found in the sediment of Laukunlampi. The vertical distribution was similar for Cs-137 and Pu-239,240 in the lakes investigated. A slight migration of Pu-239,240 and Cs-137 was found and the migration of Cs-137 seems to be higher than that of Pu-239,240. The advantages of Cs-137 dating method are rapidity and simplicity. Pu-239,240 is preferable when the sample size is small. The agreement found between Cs-137 and Pu-239,240 dates and the annual laminate show that these fallout radio isotopes can be used for dating sediments formed during the past 25 years. (Author's abstract)
W84-05206

CAESIUM-137 PROFILES IN THE SEDIMENTS OF A PARTIAL-MEROMICTIC LAKE ON GREAT SANDY ISLAND (FRASER ISLAND), QUEENSLAND, AUSTRALIA,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
M. E. Longmore, B. M. O'Leary, and C. W. Rose.
Hydrobiologia, Vol. 103, p 21-27, July, 1983. 4 Fig, 35 Ref.

Descriptors: *Cesium radioisotopes, *Lake sediments, *Hidden Lake, *Australia, Oligotrophic lakes, Fallout, Mixing, Diffusion, Bioaccumulation, Sediment recycling, Chemical stratification, Acidic water.

Hidden Lake is a perched, brown-water lake located in the center of Great Sandy Island (Fraser Is.), S.E. Queensland. It is highly acid (pH 4.0), oligotrophic and is thermally and chemically stratified for most of the year. The sediments revealed a Cs-137 profile which departed from the temporal pattern of Cs-137 fallout in Brisbane and was represented by an exponential increase of Cs-137 towards the surface sediments from ca. 32 cm depth. The possible causes of the divergent profile are discussed, including physical and biological mixing, lag in the transport of catchment material to the sedimentary basin, diffusion, recycling and biological concentration. It is hypothesized that a combination of the last four processes, with diffusion facilitated by the highly acid conditions, are the major causes of the observed Cs-137 profile. Possible recycling and bioconcentration of Cs-137 raises questions as to the validity of this method of dating in similar environmental conditions, and as to the interpretation of other paleochemical data. These hypotheses are to be tested against profiles obtained from C-14, Pb-210, Pu-239/240 analyses of the sediment, and the measurement of Cs-137 activity in the water and biota of the lake. (Author's abstract)
W84-05207

MINERAL MAGNETIC STUDIES OF LAKE SEDIMENTS,
Liverpool Univ. (England). Dept. of Geography.
F. Oldfield, C. Barnosky, E. B. Leopold, and J. P. Smith.
Hydrobiologia, Vol. 103, p 33-44, July, 1983. 5 Fig, 1 Tab, 23 Ref.

Descriptors: *Magnetic studies, *Minerals, *Lake sediments, Climates, Lake Washington, Erosion rates, Fire, Magnetic minerals, Sediment sources, Core logging.

This review outlines the origin and environmental significance of magnetic minerals in lake sediments. Attention is drawn to situations where the patterns of mineral magnetic variation is a reflection of processes other than changing erosion rates and fire incidence. In many cases simple variations in the concentration of primary magnetic minerals in allocthonous catchment-derived materials do not provide an adequate model of mineral magnetic variations in lake sediments. Depending on the environmental context, mineral magnetic variations can be used to aid the elucidation of a diversity of problems. The use of mineral magnetic techniques in sediment source tracing, paleoclimatic studies and the reconstruction of particulate pollution history is illustrated by means of case studies from Britain and North America. The value of magnetic susceptibility as an on-site core logging technique is shown by reference to data from Lake Washington. (Baker-IVI)
W84-05209

CHANGING PATTERNS OF SEDIMENT ACCUMULATION IN A SMALL LAKE IN SCANIA, SOUTHERN SWEDEN,
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
J. A. Dearing.
Hydrobiologia, Vol. 103, p 59-64, July, 1983. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Magnetic studies, *Lake sediments, *Scania, *Sweden, Magnetic minerals, Sedimentation, Cores, Climate, Deforrestation, Erosion, Infilling.

Magnetic susceptibility measurements have been used to correlate synchronous depths in cores of recent sediment taken from a small lake having an area of about 55 ha in Scania, southern Sweden. The three-dimensional picture of sediment accumulation which emerges provides a basis for studying sediment deposition patterns through time. Using a paleomagnetic chronology, the results indicate that the pattern and rate of accumulation have dramatically changed during the past 350 years. Semiquantitative studies of downcore sediment properties in a single core are thus difficult. The generally higher levels of accumulation rate in the later period could possibly reflect the low wet density values of the uppermost levels of sediment. Since different patterns of sediment accumulation are caused by changes to the internal dynamics of the limnic system, the observed patterns could be artefacts of complex slumping-redeposition cycles where different zones of the lake are periodically subject to gain or loss of sediment as thresholds for sediment slope stability are transgressed. On the basis of present evidence, sedimentation patterns may have altered in many small to medium sized lakes during the last few centuries as a result of deforestation, accelerated erosion and infilling, climatic change or water level lowering. (Baker-IVI)
W84-05210

TRACE ELEMENT ASSOCIATIONS AS INDICATORS OF SEDIMENT ACCUMULATION IN LAKES,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
L. V. Sergeeva.
Hydrobiologia, Vol. 103, p 81-84, July, 1983. 1 Fig, 4 Ref.

Descriptors: *Trace elements, *Lake sediments, Geochemistry, Paleolimnology, Trophic level, Hydrological regime, Redox potential, Factor analysis.

A geochemical study of lacustrine sediments was undertaken as part of a major paleolimnological project concerned with the impact of man on lakes. Factor analysis was applied to the geochemical data obtained from a core from one lake. Three principal factors which explained most of the variance of the initial data were identified. Factor I is related to the organic:mineral component ratio of the sediment, and can be considered as an indirect index of change in lake trophic status through time. Factor II is related to the granulometric composition of the sediment and matches evidence for changes in the hydrological regime of the lake. Factor III reflects changes in redox potential and is more closely related to process occurring within the lake than other factors. Specific geochemical associations of elements are connected with each factor and are the factor indicators. The correlation of these associations are analyzed as geochemical indices of the variability of sediment accumulation conditions in time. (Author's abstract)
W84-05212

INTERPRETATION OF LAKE QUALITY FROM CONTEMPORARY DIATOM ASSEMBLAGES,
Joensuu Univ. (Finland).
P. Huttunen, and J. Merilainen.
Hydrobiologia, Vol. 103, p 91-97, July, 1983. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Water quality, *Diatoms, *Lake sediments, Lakes, Sediments, Detrended correspondence analysis, Correspondence analysis, Reciprocal averaging, Hydrogen ion concentration, Conductivity.

Diatom assemblages from the topmost sediment of 49 lakes were ordinated by means of a program for detrended correspondence analysis and reciprocal averaging (Decorana). The lakes were ordinated to at least five rather distinct groups. The characteristic taxa of each group are also presented. Those diatoms, such as Anomoeoneis serians, Cymbella hebridica, Eunotia faba, E. tenella, Frustulia rhomboides v. saxonica, Melosire lirata f. seriata, Navicula mediocris and N. subtilissima, that are usually found in most unproductive environments characterize one group. Species that in Finnish waters are often correlated with human impact, for instance Asterionella formosa, Cyclotella pseudostelligera and C. stelligera v. tenuis are found more or less frequently in another group. On the basis of the physico-chemical properties of both catchments and lake water the five groups are distinctly different. Many of the properties, such as conductivity, calcium content, field percentage and the pH of the water support the separation of the groups on algal criteria. Some of the relationships between the component score axes and water chemistry give useful information that can be applied to paleolimnological work. In general, one particular axis corresponds relatively well with the nutrient

status of the lake. There is also a good correlation between this axis and the pH of the water in autumn and this axis and conductivity. A second axis seems to reflect the depth of the productive water layer, measured by transparency and water color. Otherwise there is no clear dependence between the water parameters and higher axes. (Baker-IVI)
W84-05213

BACTERIAL DECOMPOSITION OF ORGANIC MATTER IN LACUSTRINE SEDIMENTS,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
V. G. Drabkova.
Hydrobiologia, Vol. 103, p 99-102, July, 1983. 1 Tab, 8 Ref.

Descriptors: *Bacteria, *Decomposition, *Lake sediments, *Organic matter, *USSR, Oxygen consumption, Productivity, Redox potential, Aerobic decomposition, Oxygen demand.

Organic matter, redox potential, bacterial number, oxygen consumption by surface sediment and aquatic bacteria production were determined in lakes situated in the forest zone (Karelian Isthmus, Baltic zone, South Ural) and in the forest-steppe (South Ural) of the USSR. The lakes differ in bioproductivity and in the intensity of human influence. The amount of organic matter accumulating in the sediments is closely related to production and decomposition processes in the trophogenic layer. Processes of organic matter transformation were most active in the uppermost sediment. The quantity of bacteria shows no correlation with the organic matter content of the sediment. An increase in organic matter, up to 70-80% of dry weight, is often accompanied by a decrease in bottom bacteria. The intensity of aerobic decomposition of the labile organic matter can be judged from the oxygen demand of the sediments. It is important to differentiate between chemical and biological oxidation processes. The quantity of bottom bacteria correlates closely with the value of oxygen consumption only in cases of high sediment redox potentials. (Moore-IVI)
W84-05214

PALEOLIMNOLOGICAL RECONSTRUCTION OF THE EFFECTS OF ATMOSPHERIC DEPOSITION OF ACIDS AND HEAVY METALS ON THE CHEMISTRY AND BIOLOGY OF LAKES IN NEW ENGLAND AND NORWAY,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W84-05215

DIATOM AND CHRYSOPHYTE RELICT ASSEMBLAGES IN THE SEDIMENTS OF BLELHAM TARN IN THE ENGLISH LAKE DISTRICT,
Freshwater Biological Association, Ambleside (England).
E. Y. Haworth.
Hydrobiologia, Vol. 103, p. 131-134, July, 1983. 1 Fig, 6 Ref.

Descriptors: *Diatoms, *Lake sediments, *Blelham Tarn, *England, *Chrysophyta, Plankton, Algae, Environmental effects, Plowing, Drainage, Sedimentation, Eutrophication.

The diatom assemblage in the early nineteenth century was dominated by Cyclotella comensis Grun., C. praetermissa Lund, Achnanthes minutissima Kutz, and A. microcephala (Kutz) Grun. A series of changes in assemblages at horizons A-D has resulted in the present domination of Asterionella formosa Hassall and Melosira italica subsp. subarctica O. Muller, with other indicators of nutrient enrichment also present. Post-1947 sediments were identified by comparison with plankton records, and algal changes during that period indicate the environmental responses to changes in farming practice and domestic water supplies. It is evident from pollen and chemical data that man-induced changes in sediment deposition have occurred at various times during the last 5000 years. Correlation between minicores shows that the early ploughing, indicated by geochemistry caused little change in the diatom assemblage. Old maps show that land drainage took place between about 1830 and 1880 AD and included a slight lowering of the tarn water level. An increase in sediment accumulation rate at about 35-25 cm in core 74 AD coincides with the initial increase in Asterionella and the reappearance of Cyclotella pseudostelligera Hustedt/C. glomerata Bachman. (Baker-IVI)
W84-05217

CLADOCERAN REMAINS AS EVIDENCE OF CHANGE IN TROPHIC STATE IN THREE SWISS LAKES,
Indiana Univ. at Bloomington. Dept. of Biology.
M. M. Boucherle, and H. Zullig.
Hydrobiologia, Vol. 103, p 141-146, July, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Cladeceran, *Trophic level, *Lake Zurich, *Lake St. Moritz, *Lake Baldegg, *Switzerland, Paleolimnology, Sediments, Lake sediments, Ecological effects.

Historical information on trophic status provides useful data for management and restoration of lakes. Species composition and density of cladoceran populations changed in Lakes Zurich, St. Moritz and Baldegg as human populations increased in these watersheds. Lake Zurich sediments became annually laminated in the 1890's as a result of increased organic input as the size of the cities surrounding the lake grew. At the same time, the Bosmina species changed from a oligotrophic form (longispina) to a eutrophic form (longirostris). An increase in Daphnia spp. populations also occurred at this time in the lake's history. Bosmina longispina reappeared in the lake in 1965 as the lake's trophic status changed from eutrophic to mesotrophic due to effective sewage treatment facilities. Annual laminations appear in the Lake St. Moritz sediments about 1910. Shortly thereafter, a shift from B. longispina to B. longirostris occurred. This change in trophic status is associated with increased tourism in the area. Lake Baldegg sediments also show annual laminations beginning in 1885 and a similar shift in the Bosmina species. Other cladoceran remains were too scarce to be useful in interpreting the histories of these lakes. (Murphy-IVI)
W84-05219

EUTROPHICATION PROCESSES IN SPANISH RESERVOIRS AS REVEALED BY BIOLOGICAL RECORDS IN PROFUNDAL SEDIMENTS,
Barcelona Univ. (Spain). Facultat de Biologia.
N. Prat, and M. V. Daroca.
Hydrobiologia, Vol. 103, p 153-158, July, 1983. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Reservoirs, *Eutrophication, Trophic level, Fauna, Littoral zone, Nutrients, Oligotrophic lakes, Sediments, Insects, Crustaceans, Spain.

Eutrophication of reservoirs can be detected by changes in the abundance of insect and crustacean remains in the sediments. In recently built reservoirs, the time of impoundment can be determined through the presence of chironomid head capsules. The initial phase is characterized by highly enriched water as can be seen by the abundance of Bosmina remains. After this initial eutrophic phase, reservoirs become oligotrophic leaving few fossil remains in the sediments. But water level fluctuations are very important for the trophic status of reservoirs. A period of low water level may result in reservoir eutrophication and the development of a rich littoral fauna. (Baker-IVI)
W84-05221

SEASONAL EUTROPHICATION BY WILDFOWL IN BASINS ISOLATING FROM THE SEA; A WORKING HYPOTHESIS,
Naturhistoriska Riksmuseet, Stockholm (Sweden).
G. Linnman.
Hydrobiologia, Vol. 130, p. 159-163, July, 1983. 3 Fig, 12 Ref.

Descriptors: *Eutrophication, *Lakes, *Waterfowl, Birds, Basins, Scandinavia, Food chains, Seasonal variation, Paleolimnology.

A new and very special course of events starts in a freshwater basin just isolated from the sea. In Northwest Europe this is mainly caused by land uplift in Holocene times or by regression of the sea. Migrating birds, especially wildfowl, breeding, resting, and moulting in these often shallow, sheltered lakes along the Scandinavian coastlines might seasonally increase the alochthonous input of nutrients in the lake ecosystems and cause marked changes in biotic interactions. Wildfowl and other birds are seasonally important links in foodchains and affect the interplay of oganisms in lake basins, and even in an open bay or a fjord of restricted dimensions. They increase fertility by their droppings and by other organic matter, such as feathers and down, although they also take nutrients away from the water they visit. Birds such as swans and ducks also disturb the ordinary sedimentation of organic matter on the bottom by dipping and diving and by trampling in the littoral zone. A working hypothesis is suggested, that the wildfowl species in question were appreciably more numerous before the arrival of man. Consequently, their effect on seasonal eutrophication cannot be neglected in the paleolimnological context. (Baker-IVI)
W84-05222

EUTROPHICATION AND THE DISAPPEARANCE OF LAKES IN THE BRODNICA LAKE DISTRICT, NORTHERN POLAND AS A RESULT OF HUMAN INTERFERENCE,
Nicolas Copernicus Univ. of Torun (Poland). Inst of Geography.
Z. Churski.
Hydrobiologia, Vol. 103, p 165-168, July, 1983. 2 Fig, 4 Ref.

Descriptors: *Lakes, *Eutrophication, *Brodnica Lake District, *Poland, Drainage, Farming, Construction, Environmental effects, Water pollution effects.

A study area was selected located in an agricultural/forest region where human influence on lakes used to be minimal. The research area included about 100 lakes in Brodnica lake district in the Drweca river basin. Fifty of the lakes examined have an area less than 1 ha and a depth less than 5 m. The remaining 50 lakes have areas ranging from 1-300 ha and depths from 3-40 m. In the past 25 years a number of these lakes (29 of the 50 smaller ones) have completely disappeared and 21 others have become almost dry. Of the large lakes, 6 have disappeared and 3 are in an advanced stage of eutrophication and overgrowing. Human interference has included the pulling down of water mills (their function having been taken over by large state plants), drainage and river canalization, construction of holiday resorts without proper water purification systems, development of intensive farming with the accompanying use of mechanized farming practices, increased mineral fertilization, and the extension of roads and road traffic. (Baker-IVI)
W84-05223

RECENT GEOLOGIC DEVELOPMENT OF LAKE MICHIGAN (U.S.A.),
Illinois State Geological Survey Div., Champaign.
D. L. Gross, and R. A. Cahill.
Hydrobiologia, Vol. 103, p 193-198, July, 1983. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake sediments, *Lake Michigan, Great Lakes, Sediments, Sedimentation, Deglaciation, Sediment transport.

The stresses placed on Lake Michigan since the advent of industrialization require knowledge of the sedimentology of the whole lake in order to make informed decisions for environmental planning. Sediment accumulation rates are low. Areas of the lake receiving the most sediment average only 1 mm/a. Deep water basins average 0.1 to 0.5 mm/a. Large areas are not receiving any sediment.

Sediment was deposited rapidly, typically 5 mm/a, in the form of rock flour, during the deglaciation of both Lake Michigan and Lake Superior Basins. Then the rate of accumulation decreased by 80-90% and has remained relatively constant since final deglaciation. Sediment enters the lake from shoreline erosion, several small rivers, and by atmospheric transport. Except for the nearshore transport of sand by longshore drift, most of the sediment entering Lake Michigan is ultimately transported out to one of the depositional basins. Because active sedimentation occurs mostly in the deep water areas of the lake, the sediment remains undisturbed and contains a record of the chemical history of the lake. (Baker-IVI)
W84-05226

SEDIMENTARY CHEMISTRY OF A SMALL POLLUTED LAKE, GALLTRASK, S. FINLAND,
Helsinki Univ. (Finland). Dept. of Botany.
K. Tolonen, and J. Merilainen.
Hydrobiologia, Vol. 103, p 309-318, July, 1983. 5 Fig, 3 Tab, 24 Ref.

Descriptors: *Sedimentary chemistry, Water pollution effects, *Lake Galltrask, *Finland, Heavy metals, Accumulation, Chemical properties, Organic matter.

Lake Galltrask has been polluted by sewage discharge since the 1920s. At present the sediment-water contact experiences reducing conditions for long periods of the year. Macro nutrients N, P, K, Ca, Mg, Na and S as well as heavy metals Pb, Cu, Zn, Co, Cr, Ni, Fe and Mn were analyzed from a sediment core representing a 7000-year long history of a lake including the preceding brackish (Litorina Sea) and freshwater (Ancylus Lake) stages. Sediments were also analyzed for sedimentary pigments, algal growth potential (AGP) of the interstitial water, phosphorus fractions, pH, specific conductivity and redox potential. The annual accumulation values of several chemical elements were interpreted in light of other paleolimnological data from the same core. In the uppermost sediment stratum the influence of sewage pollution is clearly reflected by increases in total electrolyte content, pH, AGP and sedimentary pigments including myxoxanthophyll. Nickel, copper and manganese only slightly increase in the recent sediment, while other heavy metals (especially Cr and Zn) and sulfur, phosphorus, nitrogen and total organic matter are heavily concentrated in the polluted surface sediment. The interpretation of the chemostratigraphy of the lake accords with evidence of lake development based on biological analyses. (Murphy-IVI)
W84-05228

PRODUCTION OF PLANKTONIC ROTATORIA IN ORMAJARVI, AN EUTROPHICATED LAKE IN SOUTHERN FINLAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5C.
W84-05231

ROTIFERS AS INDICATORS OF LAKE TYPES IN ESTONIA,
Akademiya Nauk Estonskoi SSR, Tartu. Inst. Zoologii i Botaniki.
A. Maemets.
Hydrobiologia, Vol. 104, p 357-361, August, 1983. 3 Fig, 5 Ref.

Descriptors: *Eutrophication, *Lakes, *Rotifers, *Estonia, Oligotrophic lakes, Mesotrophic lakes, Eutrophic lakes, Trophic levels.

Data on the pelagic rotifer fauna in 10 Estonian lakes accumulated over 20 years, as well as published data are analyzed. It appears possible to distinguish between three main indicator groups: oligotrophic and mesotrophic lake species; mesotrophic and eutrophic lake species; and eutrophic lake species. The first group includes Ploesoma hudsoni, Keratella serrulata, Synchaeta grandis, Asplanchna herricki, Ascomorpha ovalis, Gastropus stylifer, Conochilus hippocrepis, partially Conochilus unicornis and Kellicottia longispina, possibly also Ascomorpha testudo, and Gastropus minor. The second species grouping includes Trichocerca capucina, Filinia longiseta, F. limnetica, Keratella quadrata, K. cochlearis tecta, K. c. hispida, Polyarthra euryptera, Keratella hiemalis, Trichocerca porcellus, and T. pusilla. The third grouping includes Brachionus spp., Anuraeopsis fissa, Pompholyx sulcata, P. complanata, Trichocerca cylindrica, and Hexarthra mira. (Baker-IVI)
W84-05232

BIOLOGICAL REACTIONS IN WATERS (BIOLOGISCHE REAKTIONEN IN GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Ingenieurbiologie.
L. Hartmann.
Wasserwirtschaft, Vol. 73, No. 11, p 442-446, November, 1983. 5 Fig, 1 Tab, 10 Ref.

Descriptors: *Organic compounds, *Decomposition, *Productivity, Phototrophs, Chemoorganotrophs, Food chain, Metabolism, Microorganisms, Enzyme reactions.

Biological reactions in waters can be summarized as 'production' and 'degradation' of organics, with an equilibrium between phototrophic and chemoorganotrophic organisms. Such equilibria do exist only under a long term observation or in large systems. But in most biotopes, due to the influence of physical parameters, a difference exists over time or space between production and degradation. This is the more the case, if food chains with bigger chemoorganotrophs are established and distributed on a large area. The dominant parameters for the velocity of food uptake and metabolism are different between different systematic groups and also depends on the diversity of the biocommunity. For biocommunities with a high diversity therefore only a summarizing observation and description of systems is possible; but for isolated systems, consisting mainly of microorganisms, the mathematics of enzyme reaction can be applied. (Author's abstract)
W84-05261

RESPONSE OF AN ANTARCTIC LAKE HETEROTROPHIC COMMUNITY TO HIGH DISSOLVED OXYGEN,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
A. T. Mikell, Jr., B. C. Parker, and G. M. Simmons, Jr.
Applied and Environmental Microbiology, Vol. 47, No. 5, p 1062-1066, May, 1984. 4 Fig, 3 Tab, 30 Ref. NSF DPP-80-12988.

Descriptors: *Lake Hoare, *Antarctica, *Dissolved oxygen, *Ecological effects, Plankton, Heterotrophic bacteria, Population exposure, Chemical properties.

The upper waters of Lake Hoare, Antarctica, contain dissolved oxygen at about three times the normal saturation ($>$ or $=$ 42 mg/liter). The response of the heterotrophic plankton community to this high dissolved oxygen was evaluated by the criteria of CFU and D-(U-C-14) glucose assimilated-respired. High dissolved oxygen was not inhibitory to D-(U-C-14) glucose assimilation-respiration compared with normal atmospheric dissolved oxygen in Lake Hoare water. The D-(U-C-14) glucose assimilated-respired in the upper saturated atmospheric dissolved oxygen waters of Mountain Lake, Va., was inhibited in contrast to Lake Hoare ($P < 0.05$). CFU formation was inhibited in both lakes. CFU represent $<$ 1% of the fluorochrome-stained direct counts in Lake Hoare. Lake Hoare planktobacteria are smaller than the planktobacteria in Mountain Lake. ATP size fractionation revealed that 39% of the ATP biomass was $<$ 0.5 micro m in Lake Hoare. (Author's abstract)
W84-05279

GALLIONELLA FERRUGINEA AS DENITRIFICATION FACTOR IN WATER POOR IN ORGANIC MATTER (GALLIONELLA FERRUGINEA, FACTEUR DE DENITRIFICATION DANS LES EAUX PAUVRES EN MATIERE ORGANIQUE),
J.-L. Gouy, P. Berge, and L. Labroue.
Comptes Rendus Hebdomadaires, Seances Academie/Sciences Serie III, Vol. 298, No. 6, p 153-156, 1984. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Gallionella, *Denitrification, *Organic matter, Nitrogen removal, Nitrates, Iron, Self-purification, Ions.

Respiratory use of nitrates by heterotrophic bacteria is a well-known phenomenon, commonly seen in soil and in water in an atmosphere poor in oxygen (EL $<$ 340 mv). Among the accountable strains isolated from the soil, 40-65% are capable of carrying out the first step, that is to say the reduction of nitrate to nitrites, but a great number more continue until obtaining gaseous products (NO, N2O, N2). Under anaerobic conditions, Gallionella ferruginea, a chemo-lithotroph iron bacteria, reduces nitrates to nitrites which, in turn, are reduced to gaseous nitrogen compounds by the ferrous ions present in the medium. This autotrophic denitrification could explain the nitrogenous purification of fresh waters, poor in organic matter. (Murphy-IVI)
W84-05286

PERIPHYTIC COMMUNITY ANALYSIS IN A SMALL OLIGOTROPIC LAKE,
Wilkes Coll., Wilkes-Barre, PA.
A. Nerozzi, and P. Siver.
Proceedings of the Pennsylvania Academy of Science, Vol. 57, No. 2, p 138-142, 1983. 7 Fig, 3 Tab, 21 Ref.

Descriptors: *Aquatic macrophytes, *Diatoms, *Lakes, Lake Lacawac, Lake Ariel, Pennsylvania, Oligotrophic lakes.

Periphytic diatom communities on four aquatic macrophytes (Brasenia schreberi, Orontium aquaticum, Sagittaria latifolia, and Pontedaria cordata) were studied in Lake Lacawac (Lake Ariel, PA), during the 1981 and 1982 growing seasons. Four sites were chosen to represent sand, mud, and bog habitats. The epiphytic diatom communities were very extensive in Lake Lacawac, and were very similar between macrophytes and habitat types, using the SIMI similarity index. In addition, communities were very stable over the two year period. Throughout the study the most dominant taxon was Tabellaria fenestrata. Achnanthes linearis, Gomphonema gracilis, and Fragilaria construens were of secondary importance. Attached diatom concentrations increased with progression of the growing season and were greatest at 15 to 45 cm from the surface. (Baker-IVI)
W84-05312

SPHAGNUM SPECIES COMPOSITION AND DISTRIBUTION IN THE BOGS OF NUANGOLA LAKE, LUZERNE COUNTY, PENNSYLVANIA,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Biological Sciences.
R. S. Wallace, and C. B. Reif.
Proceedings of the Pennsylvania Academy of Science, Vol. 57, No. 2, p 143-146, 1983. 2 Fig, 1 Tab, 17 Ref.

Descriptors: *Lakes, *Mosses, Sphagnum species, Nuangola Lake, Luzerne County, Pennsylvania, Bogs, Glacial lakes.

Thirteen species of Sphagnum moss were found in the four bog areas of Nuangola Lake, a glacially gorged basin at 335 m elevation. The areas were sampled by the transect-plot method and compared on the basis of their vascular plant cover and Sphagnum species distribution along the vegetational gradient. The Sphagnum species distribution followed the gradient of vascular vegetation when sampled using a transect-plot method, extending from the bog edge to the original lake shore. Five habitat zones were found, and Sphagnum species were distributed according to their trophic, light, and water requirements. Sphagnum fuscum, S. centrale, and S. recurvum were the dominant mosses, the first contributing more to peat formation at present. Besides the well known properties of Sphagnum in creating habitats for peat loving flora

and fauna, chemical effects of cation exchange and pH maintainance, the accumulation of Sphagnum peat to depths of several meters in Nuangola Lake bogs is an important factor effecting the limnology and succession of the lake. (Baker-IVI)
W84-05313

STUDY OF THE CYCLING OF MANGANESE AND OTHER ELEMENTS IN A SEASONALLY ANOXIC LAKE, ROSTHERNE MERE, U.K.,
Freshwater Biological Association, Ambleside (England).
W. Davison, and C. Woof.
Water Research, Vol. 18, No. 6, p 727-734, 1984. 6 Fig, 3 Tab, 40 Ref.

Descriptors: *Vertical distribution, *Lakes, *Manganese, Iron, Seasonal variation, Sediments, Lake sediments, Distribution, Sulfides, Hypolimnion, Thermal stratification, Stratification.

The vertical distribution of sulfate, dissolved sulfide, alkalinity, pH, total iron and manganese and humic substances was monitored for a year in Lake Rostherne Mere. During summer stratification Mn(II), probably of sediment origin, accumulated in the hypolimnetic bottom waters to a concentration of 50 microm. Release occurred in two stages and appeared to be related to the supply of organic material to the sediment. No ferrous iron or dissolved sulfide were detected in the water column, athough they were measured in the interstitial waters of the sediment. Ferrous sediment formation in the sediment controls the iron (II) and dissolved sulfide concentrations and so minimized the concentration gradients at the sediment-water interface. Electron acceptors other than oxygen are capable of oxidizing ferrous and sulfide ions in the water column, pH and alkalinity were the only other chemical components to show appreciable variations with depth, reflecting the biological processes of photosynthesis, respiration and decomposition. Deoxygenation of water above an active reducing sediment can be insufficient to ensure release of iron or sulfide from the sediment. The column of water must have sufficient reducing intensity, expressed in either a chemical or microbiological sense, to maintain these rapidly oxidized forms. Rostherne Mere is a finely poised system which shows manganese reduction and the initial stages of denitrification. Neither ferrous iron nor dissolved sulfide completely dominates the interstitial water and so both are maintained at low concentrations which restricts their transport to the overlying water. Any ferrous iron or sulfide which does transfer across the sediment-water interface must be oxidized by electron acceptors other than oxygen, such as nitrate and manganic ions. The lake therefore only reaches the first stage of the redox sequence observed in other systems, perhaps due to it being relatively deep with a commensurate large hypolimnetic volume which provides a substantial reservoir of substances able to consume electrons at each stage of the progression along the series of redox processes. Iron and humic substances simultaneously increased in the surface waters after a major flood indicating that they are both present in the solution in contact with the soils of the catchment. (Baker-IVI)
W84-05319

STUDY OF PHOSPHORUS PARTITIONING AND EXCHANGE IN A SOUTH AFRICAN IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
A. J. Twinch, and C. M. Breen.
Water Research, Vol. 18, No. 6, p 775-782, 1984. 4 Fig, 3 Tab, 30 Ref.

Descriptors: *Impoundments, *Phosphorus, South Africa, Radiochemical analysis, Kinetics, Enrichment, Nitrogen, Monitoring, Phytoplankton.

Radiochemical techniques were used to monitor the short-term exchange of phosphorus between soluble and particulate fractions in the water during enrichment experiments in a South African impoundment. Tracer uptake kinetics were examined under a range of conditions in the water, created by the use of a series of isolation columns. Labeled soluble fractions were separated by gel filtration and their exchange with the particulate fraction and with intact sediment cores were examined independently. Only two distinct soluble fractions were evident using the radiotracer method and their exchange characteristics with suspended particulate material and intact sediment cores differed markedly. Radiotracer partitioning contrasted with the phosphorus partitioning measured with standard chemical methods. From the data of this study the influence of nitrogen enrichment in sediment phosphate movement into the water is difficult to assess. From the similarities in response between the unenriched column and three of the four enriched columns it must be concluded that there is no evidence of a significant P flux into the phytoplankton in response to nitrogen enrichment. (Baker-IVI)
W84-05323

TEMPERATURE AND ENERGY BALANCE OF A WATER RESERVOIR DETERMINED FROM STANDARD WEATHER DATA OF A LAND STATION,
Royal Netherlands Meteorological Inst., De Bilt.
H. A. R. de Bruin.
Journal of Hydrology, Vol. 59, No. 3-4, p 261-274, November, 1982. 4 Fig, 8 Tab.

Descriptors: *Reservoirs, *Temperature, *Energy, Weather patterns, Model studies.

A model for the determination of the temperature and energy budget of a well-mixed water reservoir from standard meteorological data observed at a nearby land station is investigated. The main features are discussed. A verification of the model is given, consisting of a comparison over several years between the measured and calculated temperature of two adjacent water reservoirs. Simple modeling satisfactorily described the annual variation of temperature of this well-mixed reservoir under certain conditions. The attractiveness of the model is that it has a clear physical basis and it uses only standard meteorological observations. Moreover, because bodies of water with a depth of 10 m very often are mixed naturally by wind the model is of great practical importance. Applications of the model lie in the field of thermal pollution problems (determination of natural water temperatures, trend studies using time series of the natural water temperature computed from climatological data, and evaluation of frequency distributions of natural water temperatures), water budget studies (determination of evaporation), and planning purposes such as the estimation of the temperature of cooling ponds to be planned. (Baker-IVI)
W84-05341

2I. Water In Plants

ROOT WATER UPTAKE AND SOIL WATER DISTRIBUTION: TEST OF AN AVAILABILITY CONCEPT,
Texas A and M Univ., College Station.
R. J. Lascano, and C. H. M. van Bavel.
Soil Science Society of America Journal, Vol. 48, No. 2, p 233-237, March-April, 1984. 1 Fig, 4 Tab, 35 Ref.

Descriptors: *Root water uptake, *Soil water, *Availability concept, *Available water, Water distribution, Plant water potential, Soil water potential, Cotton, Leaf water potential, Roots, Hydraulic resistance, Transpiration, Soil-water-plant relationships.

Progressive decline of soil water supplies in the root zone causes a corresponding lowering of the water potential in the plant and symptoms collectively described as drought stress. It is currently believed that soil water availability is closely related to plant water potential. An experimental test was made of the hypothesis that the fractional water uptake by the root system from a soil layer is proportional to the root density and to the difference between the water potential in that layer and the mean leaf water potential. This theory adequately explained the water uptake by a cotton root system that was divided over a wet and dry soil compartment. It was also established that the absolute rate of water uptake from each compartment could be accurately calculated from the measured potential difference between soil and plant leaf, and from a separately measured plant hydraulic resistance, which was shown to have a value of 0.67 x 10 to the 9th power s, independent of transpiration rate. (Murphy-IVI)
W84-04870

EFFECTS OF TEXTURE ON THE RESISTANCE TO WATER MOVEMENT WITHIN THE RHIZOSPHERE,
Washington State Univ., Pullman.
K. L. Bristow, G. S. Campbell, and C. Calissendorff.
Soil Science Society of America Journal, Vol. 48, No. 2, p 266-270, March-April, 1984. 4 Fig, 1 Tab, 29 Ref.

Descriptors: *Water movement, *Soil texture, *Rhizosphere, Soil water, Soil-water-plant relationships, Irrigation scheduling, Root resistance, Transpiration, Plant water potential, Helianthus.

A growth chamber study was designed to investigate the relative importance of the resistance involved in water movement within the rhizosphere. The components considered are the soil, the soil-root interface, and the root itself. The plant species used was sunflower (Helianthus annus L.), grown in three soils of different textures. After several weeks of growth all water application was stopped and the soil allowed to dry by transpiration alone. Relevant destructive measurements were carried out during the course of the drying period, one pot being sacrificed for each set. Measurements included transpiration rate, soil and xylem water potential, rooting density, and hydraulic properties of the soils. As the soil dried, total resistance to water movement was found to increase most rapidly in the coarsest textured soil and least rapidly in the finest textured soil. A steady state model was used to partition the total resistance between the various resistive components. This enabled the root plus interfacial resistance to be quantified in terms of soil texture and water content. (Author's abstract)
W84-04875

SUBTROPICAL GRASS SPECIES RESPONSE TO DIFFERENT IRRIGATION AND HARVEST REGIMES,
Florida Univ. Agricultural Research Center, Ona.
P. Mislevy, and P. H. Everett.
Agronomy Journal, Vol. 73, No. 4, p 601-604, July-August, 1981. 5 Tab, 8 Ref.

Descriptors: *Grasses, *Crop yield, *Irrigation patterns, Clipping, Seasonal variation, Subtropic zone, Forage.

The effects of clipping height and irrigation were determined on seasonal distribution of forage yield and quality of 16 perennial grasses grown in a subtropical environment. Sixteen grasses (4 Cynodons, 3 Paspalums, 8 Digitarias, and 1 Brachiaria) were grown with or without irrigation and harvested at two stubble heights (5 and 10 cm) at 30 day intervals for 30 consecutive months. Winter forage production was highest for Cynodon spp. (27% of total annual yield) and lowest for Paspalum spp. (14% of total annual yield). Plants cut at a 5 cm stubble initially outyielded plants harvested at 10 cm. However, after 2.5 years little difference was noted except for the Paspalum spp. and Brachiaria sp. which continued to produce more forage at shorter heights. Higher in vitro organic matter digestion (IVOMD) percentages were obtained from plants cut short with no irrigation. Cynodons harvested at a 5 cm height produced highest dry matter production during the cool winter season, containing high crude protein and IVOMD levels. Dry matter yields in summer were 100 to 300% higher than in winter, however, forage quality was much lower during the summer. (Baker-IVI)
W84-04964

Field 2—WATER CYCLE

Group 2I—Water In Plants

CANOPY TEMPERATURES, WATER USE, AND WATER USE EFFICIENCY OF CORN GENOTYPES,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
T. A. Mtui, E. T. Kanemasu, and C. Wassom.
Agronomy Journal, Vol. 73, No. 4, p 639-643, July-August, 1981. 6 Fig, 6 Tab, 8 Ref.

Descriptors: *Canopy temperature, *Water use, *Corn, Drought, Heat stress, Hybrids, Irrigation effects, Crop yield, Xylem water potential, Stomatal diffusive resistance.

Because the response of plants to drought and temperature stress involves genotype-environment interactions, one needs to obtain, identify, and measure the differential response displayed by the plant genotypes so as to be able to distinguish genotypes that respond well under favorable and unfavorable environments. A field study was conducted to compare two corn hybrids (Mo17 X B73, A619 X A632) and their respective inbred parents under irrigated and nonirrigated conditions. Canopy temperature, stomatal diffusive resistance, xylem water potential, leaf area index, ear dry weight, and grain yield were determined. Water use was determined from neutron moderation measurements of the soil-water profile. The soil was a fine silty, mixed mesic, Pachic Haplustoll that holds approximately 250 mm of plant available water. Hybrids had higher grain yield, water use, and water use efficiency than the inbred parents under both irrigated and nonirrigated conditions. Water use estimates for both hybrids and inbreds were greater for irrigated than for nonirrigated treatments. Early dry weight taken as early as one week after silking was a good indicator of final ear weight, and in this particular study, was an indicator of final grain weight. Canopy temperatures were cooler for hybrids than for the inbreds which is consistent with greater water use by the hybrids. (Moore-IVI)
W84-04966

RELATIONSHIP BETWEEN CROP TEMPERATURE AND THE PHYSIOLOGICAL AND PHENOLOGICAL DEVELOPMENT OF DIFFERENTIALLY IRRIGATED CORN,
Nebraska Univ.-Lincoln. Center for Agricultural Meteorology and Climatology.
B. R. Gardner, B. L. Blad, R. E. Maurer, and D. G. Watts.
Agronomy Journal, Vol. 73, No. 4, p 743-747, July-August, 1981. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Temperature, *Water stress, *Corn, *Irrigation effects, Crop yield, Drought, Plant growth, Canopy temperature.

Quantitative data relating crop temperature under different water stress conditions to the phenological and physiological development of corn (Zea mays L.) over a growing season are lacking. This study was motivated by the need to obtain quantitative information which can be beneficially utilized by those involved in predicting crop yields and to assist those who assess the economic impact of drought on crop production. Infrared canopy temperatures and physiological and phenological measurements were made on differentially irrigated corn throughout the 1978 growing season. Irrigation treatments were designed to evaluate the effects of moisture stress on these measurements. The soil type in the experiment area is Valentine fine sand (Typic Ustipsamment). The effect of moisture stress on vegetative growth was demonstrated by an average height difference of 50 cm between fully irrigated and nonirrigated plants. There was a tendency for plants which had been subjected to moisture stress during the grain filling stage to mature faster than plants fully irrigated during that period. Yield reductions were greatest when stress occurred during the pollination or grain filling periods. Canopy temperature increases between the onset of tasseling and the end of grain fill were related to reduced yields. Five crop temperature indices were tested for their relationship to phenological stage of growth. Three were highly correlated, one had a low correlation, and one was not correlated with phenological development. (Author's abstract)
W84-04968

EFFECTS OF SEEDING DATE AND POPULATION ON WATER-USE EFFICIENCY AND SAFFLOWER YIELD,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
J. Alessi, J. F. Power, and D. C. Zimmerman.
Agronomy Journal, Vol. 73, No. 5, p 783-787, September-October, 1981. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Safflower, *Water use efficiency, *Crop yield, Soil water, Cultural practices, Seeding date, Plant population.

Oilseed crop production has increased greatly in the Northern Plains in recent years. Cultural practices to optimize oilseed production were studied for 4 years (1974-1977) to obtain information on safflower (Carthamus tinctoris L.) seed yield, oil concentration, and water-use efficiency as affected by seeding date and plant population. Safflower was seeded on previously cropped or fallow land on three dates: early (16 May), midseason (6 June), or late (25 June) on Temvik silt loam (Typic Haploborolls). Soil water depletion by safflower was generally confined to the upper 150-cm soil depth. Average water use by safflower seeded in mid-May was greater by 4 and 8 cm than that used by the midseason and late seeding, respectively, and was unaffected by population. Significant positive correlations ($r = 0.78$) were obtained between oil concentration and degree days for the period after flowering. Correlation coefficients showed that 79% of the total variation in oil concentration was accounted for by variation in water use and temperature. Average water-use efficiency for mid-May, early June, and late June seedings was 34, 33, and 15 kg seed/cm water used, respectively. Seed and oil yields were highest for early and lowest for late seeding. In all years, seeding date affected seed yield and oil concentration. Population affected seed and oil yield in 1976. The results showed that safflower grown under dryland conditions in the Northern Plains should be seeded not later than mid-May. Previous research in North Dakota showed that for best results safflower should be planted between 20 April and 10 May. (Author's abstract)
W84-04969

DETERMINING SOIL-INDUCED PLANT WATER POTENTIAL DEPRESSIONS IN ALFALFA BY MEANS OF INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
S. B. Idso, R. J. Reginato, D. C. Reicosky, and J. L. Hatfield.
Agronomy Journal, Vol. 73, No. 5, p 826-830, September-October, 1981. 6 Fig, 15 Ref.

Descriptors: *Alfalfa, *Soil-water-plant relationships, *Infrared thermometry, Remote sensing, Plant water potential, Forages, Water stress, Air temperature, Foliage temperature.

To ascertain the ability of a remote sensing technique to evaluate the soil-induced component of plant water potential depressions in forage crops, field experiments were conducted to measure the air vapor pressure deficit and foliage-air temperature differentials of well-watered alfalfa (Medicago sativa L.) at five different sites throughout the United States. At two of these sites, data were also acquired for various degrees of stressed alfalfa along with concurrent measurements of total plant water potential. The temperature and vapor pressure data were used to construct a plant water stress index which was related to the plant water potential. Different results were obtained for the two sites studied; but after a procedure was developed to remove variable atmospheric effects, the remaining soil-induced plant water potential depressions were found to be well described by a single function dependent upon the plant water stress index. These results demonstrate the ability of surface temperature measurement by means of infrared thermometry to rapidly assess large areas of cropped land for plant water potential depressions arising from shortages of soil moisture. (Author's abstract)
W84-04970

SEASONAL DROUGHT RESPONSE OF SELECTED WHEAT CULTIVARS,
Agricultural Research Service, Florence, SC. Coastal Plains Soil and Water Conservation Research Center.
R. E. Sojka, L. H. Stolzy, and R. A. Fischer.
Agronomy Journal, Vol. 73, No. 5, p 838-845, September-October, 1981. 3 Fig, 7 Tab, 32 Ref.
Rockafeller Foundation grant RF-72035.

Descriptors: *Wheat, *Water stress, *Drought, *Seasonal variation, Soil water, Water use, Irrigation effects, Crop yield.

Wheat cultivars vary in their response to water stress. There is a high correlation between a cultivar's seasonal plant water status (Psi x) and its yield, which is unique to each cultivar. Plant water status measurements were used to compare the drought response of selected wheat cultivars in a two year field experiment. Yield, xylem pressure potential (Psi x), adaxial leaf diffusive resistance (Rs), and soil water content (Theta) were monitored in 12 cultivars of Triticum aestivum and T. durum, and two of Tritosecale. Genotypes with lower seasonal Psi x generally had higher percent yield reduction, when yield was expressed as a percent of irrigated controls. Water use during the observation period in the second season was similar for all droughted treatments and cultivars (about 17 cm H2O) which was less than half that of the irrigated controls (44 cm H2O). Late in the second season, Psi x decreased to as low as -47 bars in some treatments. Correlation between midday Psi x and yield (absolute or percent of control) for individual cultivars were highly significant. The importance of full night Psi x recovery to near zero was apparent since for three cultivars studied intensively, 80% of the yield difference between nonstressed controls and stressed treatments had already accrued when pre-sunrise Psi x decreased to -7 bars. Further reduction of predawn Psi x to -38 bars was associated with only an additional 20% of the yield loss. The relative insensitivity of flag leaf adaxial diffusive resistance to cultivar differences under stress would seem to rule it out as a screening tool for water stress resistance in cereals. (Moore-IVI)
W84-04971

WATER USE BY FORAGE SPECIES,
Agricultural Research Service, Cheyenne, WY. High Plains Grasslands Research Station.
M. L. Fairbourn.
Agronomy Journal, Vol. 74, No. 1, p 62-66, January-February, 1982. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Water use efficiency, *Forages, *Grasses, Soil water, Clover, Alfalfa, Vetch, Sainfoin, Evapotranspiration.

Forage production on the High Plains of Western United States might be done more economically if research provided more water-use information for species. A study was made to determine (1) water-use efficiency and (2) ability to use available soil water during a harvest growing period. Forages common to the area were evaluated in both greenhouses and field environments. The legume species evaluated were 'Alsike' clover (Trifolium hybridum). 'Dawson', 'Fremont', 'Ladak', 'Team', 'Travois', and 'Vernal' alfalfa (Medicago sativa L.), 'Lutana' cicer milkvetch (Astragalus cicer L.), and 'Remont' sainfoin (Onobrychis vicaefolia Scop.). Pasture grasses evaluated were 'Fawn' tall fescue (Festuca arundinacea Schreb.), 'Garrison' creeping foxtail (Alopecurus arundinaceus Poir), 'Latar' orchardgrass (Dactylis glomeranta L.), 'Grennar' intermediate wheatgrass (Agropyron intermedium (Host) Beauv. L.), thickspike wheatgrass (A. dasystachyum (Hook) Scribn.) and 'Regar' bromegrass (Bromus biebersteinii Roem and Schult.); while range grasses were blue grama (Bouteloua gracilis (H.B.K.) Lag), crested wheatgrass (Agropyron desertorum (Fisch. ex Link) Schult.), slender wheatgrass (A. trachycaulum (Link) Malte), western wheatgrass (A. smithii Rydb.), and green needlegrass (Stipa viridula Trin.). The study was made on Altvan soil, a fine, sandy, clay loam belonging to the mixed mesic family of aridic arguistolls. Water use was monitored by gravime-

tric method and by tensiometers in the first and second studies, respectively. Transpiration in the greenhouse during a crop growing period ranged from 7.2 cm for the milkvetch to 15.5 cm for Regar bromegrass. Blue grama had the highest water-use efficiency of all species but was able to utilize only a relatively small amount of the available water in forage production. Growing the plants in a field environment increased evapotranspiration by 100 to 200% compared with that in the greenhouse. Thickspike wheatgrass appeared to be capable of adapting to either a semiarid or humid climate but range grasses studied were unable to use large amounts of available water. (Author's abstract)
W84-04975

PLANT RESISTANCE TO WATER FLOW IN FIELD SOYBEANS: I. NON-LIMITING SOIL MOISTURE,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
J. W. Jones, B. Zur, K. J. Boote, and L. C. Hammond.
Agronomy Journal, Vol. 74, No. 1, p 92-98, January-February, 1982. 6 Fig, 1 Tab, 24 Ref. USDA grant 801-15-58.

Descriptors: *Soybean, *Plant water flow resistance, Transpiration, Soil water potential, Plant water potential.

Predictions of plant water relations and transpiration require estimates of resistances to water flow in the soil and in the plant. A field experiment was conducted to determine plant resistance to water flow under field conditions during two periods of soybean (Glycine max) growth, on Arredondo fine sand (hypothermic, coated Typic Quartzipsamment). Root depth distributions were measured during each growth period and soil water potential distributions were measured daily. Every other day, during the periods 4 to 16 May (Exp. I) and 30 May to 7 June (Exp. II), hourly measurements of leaf water potential and transpiration were used to calculate plant resistance using Ohm's law analogy. Daily plant resistance was calculated using midday leaf water potential and total integrated transpiration for each day. Calculated plant resistance increased with transpiration flux in a nonlinear relationship. When plant resistance values for quasi-steady state conditions during midday hours were examined, they averaged 940 MPa h/sq cm for the first experiment, independent of transpiration flux over a range of 0.02 to 0.05 cm/h. Plant resistance values increased with time and averaged 2,360 MPa h/sq cm for quasi-steady state conditions in the second experiment. Plant resistance values calculated on a daily basis averaged 200 and 300 MPa-day/sq cm for the first and second experiments, respectively, 3 to 5 times higher than plant resistance values based on hourly measurements. Plants are seldom at steady state under natural conditions, and random or average measurements of leaf water potential do not represent the true driving force for water transport through this complex system. (Moore-IVI)
W84-04976

TOTAL RESISTANCE TO WATER FLOW IN FIELD SOYBEANS: II. LIMITING SOIL MOISTURE,
Florida Univ., Gainesville. Dept. of Soil Science.
B. Zur, J. W. Jones, K. J. Boote, and L. C. Hammond.
Agronomy Journal, Vol. 74, No. 1, p 99-105, January-February, 1982. 7 Fig, 2 Tab, 16 Ref. USDA grant 801-15-58.

Descriptors: *Soybean, *Plant water flow resistance, *Soil water flow resistance, Transpiration, Soil water potential, Roots, Permeability coefficient, Plant water potential, Irrigation effects.

Experiments were conducted to determine the total (soil plus plant) resistance to water flow through field grown soybeans (Glycine max (L.) Merr.) subjected to two drying cycles during pod addition and early pod fill (4 to 16 May) and mid-to-late pod fill (30 May to 7 June). Root length density distributions with depth were measured during each drying cycle and soil water potential distributions were measured daily. The experiment was conducted in the field on Arredondo fine sand (hypothermic, coated Typic Quartzipsamments). Transpiration flux and leaf water potential measured hourly every 2 days during each drying cycle were used with daily measurements of soil water potential to calculate total resistance. Midday transpiration rates decreased relative to transpiration rates of irrigated plots starting 8 and 5 days after irrigation for the first and second drying cycles, respectively, when average soil water potential was - 0.04 MPa. The increase in total resistance which corresponds to the decrease in transpiration flux was attributed to increased soil resistance. However, calculated soil resistances based on experimental results were four to six orders of magnitude higher than theoretical calculations of the bulk soil resistances based on the Gardner (1960) model. Calculations of water potential at the root surface during drying conditions indicate that unsaturated hydraulic conductivity of soil adjacent to the root may be several orders of magnitude lower than that of the bulk soil and could explain the observed reduction in the transpiration flux. (Author's abstract)
W84-04977

YIELD, YIELD COMPONENTS, AND NUTRIENT CONTENT OF CORN GRAIN AS INFLUENCED BY POST-SILKING MOISTURE STRESS,
H. J. Harder, R. E. Carlson, and R. H. Shaw.
Agronomy Journal, Vol. 74, No. 2, p 275-278, March-April, 1982. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Corn, *Water stress, *Crop yield, Irrigation timing, Precipitation, Soil water, Plant physiology, Phosphorus, Potassium.

Sensitivity of corn (Zea mays L.) grain development to moisture stress is related to the physiological stage of development when stress occurs. For this reason the time when moisture stress occurs is important in determining final grain yield; hence, timing of precipitation or irrigation becomes an important economic factor in corn production. The primary objective of this work was to determine the effect of successive, repetitive moisture-stress treatments on yield and yield components. To accomplish this goal, experiments were conducted in the movable rain shelter facility at Ames, Iowa, during the summers of 1976 and 1977. With this facility, different soil-moisture conditions were imposed simultaneously with plants growing under similar conditions of atmospheric demand. Corn plants were grown in containers with 100 liters of a Nicollet loam soil (an Aquic Hapludoll, fine-loamy mixed mesic). Single and multiple periods of moisture stress were imposed after silking in one, two, or three successive stress cycles to study their effect on grain yield and yield components (kernels/plant and mass/kernel). Successive respective stress treatments on the same plants were included to observe plant response to moisture stress after sink size (kernel number) was altered because of previous stress. Grain yield reductions of up to 33% depended primarily upon severity and duration of soil-moisture stress. Additional stress cycles did not always cause an additive reduction in grain yield. Moisture stress that occurred within 2 weeks after silking reduced the number of kernels/plant by about 15% with little influence on final mass/kernel. Additional stress cycles had only minor effects on kernel number. Plants that were stressed shortly after silking and suffered reduction in kernels/plant had shorter, but uniformly filled ears, suggesting that stress-inhibited development of kernels at the tip of the ear. Moisture stress influenced mass/kernel in a complex fashion. Decreases up to 20% were observed. The observed pattern for mass/kernel depended on the timing of stress in relation to silking date and previous moisture-stress history of the plant. Moisture stress increased % N in the grain from 1.7% in controls to 1.8 and 1.9% in one and two repeated stress cycles, respectively, but did not significantly influence % P or % K in the grain at harvest. (Author's abstract)
W84-04978

SALT AND WATER STRESS EFFECTS ON GERMINATION OF GUAYULE SEEDS,
Texas A and M Research and Extension Center, El Paso.
S. Miyamoto, K. Sosnovske, and J. Tipton.
Agronomy Journal, Vol. 74, No. 2, p 303-307, March-April, 1982. 3 Fig, 4 Tab, 6 Ref.

Descriptors: *Guayule, *Germination, *Saline water, *Water stress, *Texas, Saline soils, Irrigation water, Irrigation effects, Specific ion effects.

West Texas is considered one of the key potential guayule producing areas. Guayule (Parthenium argentatum), a rubber producing desert shrub, is native to this region. In cultivating guayule, salinity may pose a problem, since many of the irrigated soils and irrigation waters in this region are affected by salt. Studies were performed to evaluate salt and soil water stress effects on seed germination. The test materials included four USDA selections (11646, 11604, 11633, and A48118) and one cultivar (593). Petri dish solution cultures were used for evaluating salt effects, and two sandy soils (Typic Torrifluvents and Typic Torripsamments) placed in petri dishes were used for studying soil water stress effects. Increasing salt concentrations slowed germination, especially when salt concentrations exceeded 200 meq/l or the electrical conductance of 15 mmho/cm. Seed germination may be reduced by approximately 25%, due to salinity of salt solutions ranging from 7 to 19 mmho/cm with a descending order of tolerance of 11646, 593, 11604 = 11633, and A48118. Selection 11646 showed excellent characteristics as well as high salt tolerance. Specific ion effects were insignificant when tested in salt solutions having mixed ion compositions. Soil water stress needs to be controlled at less than about 0.8 bar if germination is to be accomplished without adverse effects of water stress. Salinity will not be a factor in reducing germination in west Texas, as long as irrigation is performed in such a way that no salt accumulation occurs in the seed zone. (Moore-IVI)
W84-04979

COMPARISON OF WATER STRESS OF COTTON FROM MEASUREMENTS WITH THE HYDRAULIC PRESS AND THE PRESSURE CHAMBER,
California Univ., Davis. Dept. of Land, Air and Water Resources.
R. A. Radulovich, C. J. Phene, K. R. Davis, and J. R. Brownell.
Agronomy Journal, Vol. 74, No. 2, p 383-385, March-April, 1982. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Cotton, *Water stress, *Hydraulic press, *Pressure chamber, Plant water potential, Irrigation scheduling, Measurement instrumentation.

The pressure chamber (PC) technique for the determination of leaf water potential has become universally accepted, but the hydraulic press (HP) technique for the estimation of plant water status has some advantages over the PC technique. Measurements of water status of cotton obtained with the HP and the PC were compared and correlated in replicated experiments under greenhouse and field conditions. The HP could very well replace the PC for green house applications. In field experiments, the HP does not measure low water potential accurately below -940 kPa as determined by the PC. With cotton, the most representative endpoint to use with the HP is the pressure at which water exudes from the cut edge of a tip of an uppermost fully expanded leaf. The HP can be used advantageously for irrigation scheduling of cotton if the threshold value is -940 kPa or higher, as determined when the highest water potential values for a day are found (i.e., predawn). The inability of the HP to estimate low water potentials of cotton leaves, under these conditions, seems to be a serious limitation of the instrument. (Moore-IVI)
W84-04981

INTERRELATIONSHIPS OF IRRIGATION FREQUENCY, UREA NITROGEN, AND

GYPSUM ON FORAGE SORGHUM GROWTH ON A SALINE SODIC CLAY SOIL,
M. A. Mustafa, and E. A. Abdelmagid.
Agronomy Journal, Vol. 74, No. 3, p 447-451, May-June, 1982. 6 Tab, 19 Ref.

Descriptors: *Irrigation frequency, *Sorghum, *Saline soils, *Gypsum, *Fertilizers, Forages, Plant growth, Nitrogen, Semiarid lands, Crop yield, Evaporation, Germination, Water use efficiency.

Two field experiments were conducted in June, 1978, and April, 1979, at the Khartoum University Farm, Sudan, to study the effect of irrigation frequency, urea-nitrogen, and gypsum on the yield of forage sorghum (Sorghum vulgare L.) grown on a semi-arid, saline-sodic clay soil. Each experiment had four nitrogen levels: 0N, 1N, 2N, and 3N (1N = 43.8 kg N/ha) applied as urea; three irrigation frequencies; 7, 10, and 15 days; and zero or 11.9 tonnes/ha gypsum, each replicated thrice in a split-split plot design. The seasonal quantity of water applied was the same for all frequencies of irrigation and was slightly higher than evaporation from a U.S. class A pan. The two seasons data consistently showed that dry matter yield of the first cuts of forage sorghum increased significantly with increase in N-level, with decrease in irrigation interval, and with gypsum application. Decreased irrigation frequency had greater effect than 3N fertilization. The benefits from gypsum application were low (5%) at the 7-day irrigation interval. Dry matter yields were increased from 1.84 to 6.12 tonnes/ha in 1978 and from 3.20 to 7.23 tonnes/ha in 1979, by irrigating every 7 days instead of 15 days, application of 3N and 11.9 tonnes/ha gypsum. Plant height and leaf area index increased with N fertilization, with gypsum and with reduction of irrigation interval from 15 to 7 days, whereas germination percentage was significantly increased by gypsum only. Dry matter yield significantly correlated (P = 0.01) with leaf area index and plant height but not with germination percentage. Multiple regression analysis showed that the first two growth attributes accounted for about 87% of the variability of yield. The dry matter yields of the second cuts were similarly affected by treatments but were about one-half to one-third those of the first cuts in 1978 and 1979 seasons, respectively. For the two seasons the average seasonal water-use was about 1.02 times that of the U.S. class A pan evaporation. Water-use efficiency increased from 15.6 to 43.9 kg/ha-cm in 1978 and from 19.1 to 51.2 kg/ha-cm in 1979, by irrigating every 7 days instead of 15 days, and applying 3N urea and 11.9 tonnes/ha gypsum. (Author's abstract)
W84-04984

EFFECTS OF PLANT AND ROW SPACING ON DRYLAND SOYBEAN YIELD AND WATER-USE EFFICIENCY,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 3F.
W84-04990

RESPONSE OF DRIP-IRRIGATED SUGARCANE TO DROUGHT STRESS,
Lihue Plantation Co. Ltd., Kauai, HI.
For primary bibliographic entry see Field 3F.
W84-04991

EFFECT OF CROP RESIDUE MANAGEMENT AND TILLAGE ON WATER USE EFFICIENCY AND YIELD OF WINTER WHEAT,
Agricultural Research Service, Pullman, WA.
For primary bibliographic entry see Field 3F.
W84-04992

EFFECT OF IRRIGATION AND ROW SPACING ON SOYBEAN WATER USE,
Agricultural Research Service, Morris, MN.
For primary bibliographic entry see Field 3F.
W84-04995

DROUGHT RESPONSE OF SORGHUM HYBRIDS UNDER A SPRINKLER IRRIGATION GRADIENT SYSTEM,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 3F.
W84-04999

YIELD AND YIELD COMPONENTS OF 'BRAXTON' SOYBEANS AS INFLUENCED BY IRRIGATION AND INTRAROW SPACING,
Clemson Univ., SC. Dept. of Agronomy and Soils.
For primary bibliographic entry see Field 3F.
W84-05002

WATER STRESS STATUS IN GUAYULE AS MEASURED BY RELATIVE LEAF WATER CONTENT,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 3F.
W84-05009

WATER STRESS, GROWTH, AND CRITICAL WATER POTENTIALS OF RABBITEYE BLUEBERRY (VACCINIUM ASHEI READE),
Florida Univ., Gainesville. Dept. of Fruit Crops.
F. S. Davies, and C. R. Johnson.
Journal American Society of Horticultural Science, Vol. 107, No. 1, p 6-8, 1982. 2 Fig, 1 Tab, 18 Ref.

Descriptors: *Water potentials, *Water stress, *Blueberry, Stress, Plant growth, Critical water potentials, Crop yield, Transpiration.

The relationship between critical water potential and relative water content (RWC) to rabbiteye blueberry drought-tolerance was investigated as well as the effects of moderate and severe water-stress on growth of containerized rabbiteye blueberry plants. Growth, expressed as leaf area and root, stem and leaf dry weights, was decreased significantly by both moderate and severe water-stress. The root:shoot ratio was not altered significantly by water-stress, indicating that growth of roots and shoots was balanced even during water deficits. Critical water potential for stomatal closure was -2.2MPa, transpiration ratio averaged 222 g of water transpired per g dry matter produced and relative water content changed 6.4% per 1.0 MPa change in water potential. (Baker-IVI)
W84-05059

WATER RELATIONS OF WELL-WATERED, MYCORRHIZAL, AND NON-MYCORRHIZAL ONION PLANTS,
Michigan State Univ., East Lansing. Dept. of Botany and Plant Pathology.
C. E. Nelson, and G. R. Safir.
Journal of the American Society of Horticultural Science, Vol. 107, No. 2, p 271-274, 1982. 2 Fig, 19 Ref.

Descriptors: *Phosphorus, *Permeability, *Plant water potentials, *Onions, Mycorrhizal fungi, Nutrients, Soil properties, Leaves, Water potentials, Phosphorus, Roots.

The water relations of mycorrhizal onions were compared with those of non-mycorrhizal controls grown under low and high soil phosphorus conditions. Mycorrhizal plants had higher leaf water potentials, higher transpiration rates, higher hydraulic conductivities and lower leaf resistances than did non-mycorrhizal plants grown in low soil phosphorus conditions. When controls were grown under high soil phosphorus conditions, the measured parameters were not different from those of mycorrhizal plants. The magnitude of the effect of mycorrhizal fungi on the water relations of the host may, in part, be a function of phosphorus nutrition. The fact that added phosphorus affects the water relations of the onion in the same way that the mycorrhizal fungus does suggests that the primary cause of the changes is nutritional. A model root system has been suggested where changes in membrane permeability can have large effects on root resistance to water flow. This may explain the effects of mycorrhizae on hydraulic conductivity. The differences in leaf water pote tials, transpiration rates and leaf resistance are co sidered to be the result of the differences found hydraulic conductivities. (Baker-IVI)
W84-05060

WATER STRESS EFFECTS ON PICKING CU CUMBER,
Ohio Agricultural Research and Developme Center, Wooster. Dept. of Horticulture.
D. G. Ortega, and D. W. Kretchman.
Journal of the American Society of Horticultur Sciences, Vol. 107, No. 3, p 409-412, 1982. 2 Fig, Tab, 22 Ref.

Descriptors: *Plant growth, *Water stress, *Cu cumbers, Crop yield, Water potentials, Leave Plant water potential, Fruit.

The peculiar growth patterns of cucumbers wer examined along with the causes for the differenc in fruit growth and plant development due t water stress. Seven days after treatment initiatio vine length of the non-stressed plants had increase an average of 11 cm, while the stressed plants ha increased 2 cm. Two weeks after treatment init ation, vine length of the control plants had in creased an average of 13 cm, while stressed plan had ceased to grow. Plant node number was affec ed to a lesser extent by water stress. Node numbe on stress plants was significantly less only at 1 days after treatment initiation. Fruit growth rate c non-stressed plants was initially high and decrease with time. Rate of length increase was greater tha diameter rate but declined to a similar level c increase. Growth rates of fruit on stressed plant were much less than those of non-stressed plants Osmotic and water potentials of fruits and leave were determined 1 week after treatment initiation Osmotic potentials for the stressed fruits and leave were generally lower than for their non-stresse counterparts. Large stressed fruits possess the abili ty to prevent large decreases in water conten despite a decrease in water potential, an actio which favors survival during stress. This charac teristic is probably due to fruit osmotic adjustmen in which there is an increase in solute content pe cell without a decrease in water content. (Baker IVI)
W84-05061

RESPONSE OF SQUASH TO IRRIGATION, NI TROGEN FERTILIZATION, AND TILLAGE SYSTEMS,
Georgia Coastal Plain Experiment Station, Tifton.
D. A. Smittle, and E. D. Threadgill.
Journal of the American Society of Horticultural Science, Vol. 107, No. 3, p 437-440, 1982. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Squash, *Tillage, Fertilization, Nitrogen, Water conservation, Moisture tension.

The response of squash to combinations of irrigation, N fertilization and tillage methods was investigated. Dixie squash were subjected to factorial combinations of 2 irrigation levels, 4 N treatments, and 3 tillage methods on a Lakeland sand soil during 1978, 1979, and 1980. The greatest marketable fruit yield resulted from a combination of applying irrigation at 0.3 bar soil water tension, applying 2.5 kg N/ha through the irrigation system at 2, 3, 4, 5, and 6 weeks after planting, and preparing the seedbed by moldboard plow tillage. Yields were reduced 3 to 16% by either reducing the N rate, allowing a greater soil water tension before irrigation, or by the use of subsoil-bed or disk-harrow tillage system. A combination of subsoil-bed tillage and application of irrigation at 0.6 bar soil water tension resulted in the greatest yield when squash received a single N application after planting. Squash yield was reduced 13% when irrigated at 0.3 bar with subsoil-bed tillage. Yields of squash irrigated at 0.6 bar soil water tension were 12% and 37% lower with moldboard plow and disk than with subsoil-bed tillage. (Baker-IVI)
W84-05062

RAPID METHOD TO ESTIMATE FRUIT WATER STATUS WITH SPECIAL REFERENCE TO RAIN CRACKING OF SWEET CHERRIES,
Oregon State Univ., Corvallis. Dept. of Horticulture.
P. C. Anderson, and D. G. Richardson.
Journal of the American Society of Horticultural Science, Vol. 107, No. 3, p 441-444, 1982. 3 Fig, 2 Tab, 25 Ref.

Descriptors: *Fruit crops, *Water potentials, *Cherries, *Rain cracking, Cracking, Osmotic pressure, Turgor, Soluble solids.

A technique is described whereby osmotic potential, turgor potential and total fruit water potential can be determined quickly in the field with the aid of a pressure bomb, a hand held refractometer, and a percent soluble solids to osmotic potential conversion chart. A unique inverse linear relationship between percent soluble solids and osmotic potential was found for each fruit species examined. A calibration curve was compiled relating percent soluble solids by refractometry and osmotic potentials by psychrometry. Turgor pressure was obtained by subtracting the osmotic equivalent of percent soluble solids from total fruit water potential determined by a pressure chamber apparatus. Therefore, total, osmotic and turgor potentials can be determined in the field in a matter of minutes. The technique when applied to rain cracking of Napoleon sweet cherries provided additional evidence that rain cracking is not a direct function of percent soluble solids, osmotic potential, turgor potential or fruit water potential. (Baker-IVI)
W84-05063

EFFECTS OF RAINFALL AND IRRIGATION MANAGEMENT ON CITRUS JUICE QUALITY IN TEXAS,
Agricultural Research Service, Weslaco, TX.
R. R. Cruse, C. L. Wiegand, and W. A. Swanson.
Journal of the American Society of Horticultural Science, Vol. 107. No. 5, p 767-770, 1982. 3 Tab, 15 Ref.

Descriptors: *Irrigation practices, *Fruit crops, Oranges, Grapefruit, Crop yield, Water stress, Irrigation, Plant growth.

Four different irrigation regimes were tested on 2 sizes of Marrs and Valencia oranges, and on Citrus sinensis Osbeck and Ruby Red grapefruit. The fruit was examined for juice yield, degrees Brix (soluble solids), citric acid, suspended solids, L-ascorbic acid (Vitamin C), pH, and naringin content. In the area of study, natural rainfall contributes about half the annual water requirement to the plants. In Marrs oranges the only juice characteristic affected with any consistency was soluble solids. Brix decreased with increasing water availability to trees. Vitamin C content was significantly higher in the wettest treatment in 1973, which was also a year of high rainfall. In grapefruit, pH, Vitamin C, juice yield, and suspended solids were only infrequently affected by combined irrigation and rainfall. In Valencia oranges, the juice yield of size 125 was affected by irrigation treatments in 4 of the 6 years, whereas the juice yield of size 200 was affected in only 2 of the 7 test years. The most consistent effects over the years of the study of irrigation treatments occurred in the Marrs orange, where in all cases of significance, the juice attributes decreased in value in the order of increasing frequency of irrigation. (Baker-IVI)
W84-05064

EFFECT OF SOIL MOISTURE STRESS TO VARIOUS FRACTIONS OF THE ROOT SYSTEM ON TRANSPIRATION, PHOTOSYNTHESIS, AND INTERNAL WATER RELATIONS OF PEACH SEEDLINGS,
Department of Agriculture, Harrow (Ontario). Research Station.
For primary bibliographic entry see Field 2D.
W84-05065

EFFECT OF REDUCED WATER SUPPLY ON PEACH TREE GROWTH AND YIELDS,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 3F.
W84-05066

WATER RELATIONS AND FROND CURL OF CUT LEATHERLEAF FERN,
Florida Univ., Gainesville. Dept. of Ornamental Horticulture.
T. A. Nell, J. E. Barrett, and R. H. Stamps.
Journal of the American Society of Horticultural Science, Vol. 108, No. 4, p 516-519, 1983. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Ferns, *Water potential, *Fronds, Stomata, Postharvest, Dessication, Water uptake.

Leatherleaf fern (Rumohra adiantiformis (G. Forst) Ching) fronds became desiccated rapidly after harvest with water potential decreasing from -0.45 to -1.75 MPa within 30 minutes. Partial closing of stomates 30 minutes after harvest accounted for a decrease in the rate of frond desiccation and frond water potential was -2.26 MPa after 180 minutes. Postharvest frond desiccation to water potentials of -1, -2, and -3 MPa in the field prior to water dip and cold storage resulted in frond curl of 32, 56, and 84%, respectively, when placed in postharvest rooms. Water uptake decreased during the first 4 days in postharvest rooms. Declining frond water potentials suggested reduced rate of water uptake was due to blockage of the xylem. However, no obstructions were observed at cut end of stipe from fern with frond curl or those not exhibiting frond curl. Frond water potentials were lower one hour after harvest than when undergoing normal postharvest senescence. Fronds did not exhibit normal drought-imposed wilt or frond curl during prestorage stress. Desiccation resulted in frond curl in some experiments but had little effect in others. These results indicate that frond curl can be triggered by desiccation stress but other factors are predisposing fronds to this disorder. (Author's abstract)
W84-05070

WATER RELATIONS AND GROWTH OF SNAP BEANS AS INFLUENCED BY DIFFERENTIAL IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Horticulture.
For primary bibliographic entry see Field 3F.
W84-05074

EFFECT OF NITROGEN RATE AND WATER STRESS ON GROWTH AND WATER RELATIONS OF YOUNG SWEET CORN PLANTS,
Cook Coll., New Brunswick, NJ. Dept. of Horticulture and Forestry.
A. J. Tesha, and P. Eck.
Journal of the American Society of Horticultural Science, Vol. 108, No. 6, p 1049-1053, 1983. 6 Fig, 20 Ref.

Descriptors: *Corn, *Water stress, *Nitrogen, Stomata, Chlorophyll, Drought resistance, Water potential, Water content.

Seedlings of sweet corn (Zea mays L. cv. Iochief) were grown in sand with 3 rates of N at a moderate and severe water-stress rate produced by adding polyethylene glycol (PEG 6000) to the nutrient solution. As water stress increased, dry-matter production decreased. Increasing N rate compensated in part for the loss in dry-matter production that resulted from the water stress. Leaf chlorophyll levels and stomatal density on the abaxial leaf surface increased with an increase in N, and a faster recovery of the relative water content of leaf tissue following water-stress treatment occurred. All 3 responses could have contributed to the N response in dry-matter production observed at the 2 water-stress levels. A low N rate may aid young sweet corn seedlings under severe water stress to resist drought, as indicated by a stabilization in dry-matter production in plants receiving only 8 mM N in the nutrient solution when moving from moderate to severe water stress. These plants had a higher relative water content and leaf water potential under severe water stress than plants receiving higher rates of N, which may have contributed to the ability of plants receiving a low-N rate to cope with the severe water stress. (Author's abstract)
W84-05075

LEAF CONDUCTANCE, GROWTH AND SURVIVAL OF WILLOW AND DECIDUOUS FRUIT TREE SPECIES UNDER FLOODED SOIL CONDITIONS,
Oregon State Univ., Corvallis. Dept. of Horticulture.
P. C. Andersen, P. B. Lombard, and M. N. Westwood.
Journal of the American Society of Horticultural Science, Vol. 109, No. 2, p 132-138, 1984. 6 Fig, 4 Tab, 29 Ref.

Descriptors: *Trees, *Flood tolerance, Leaf conductance, Plant growth, Apple, Pear, Quince, Peaches, Willow, Abscission, Soil oxygen diffusion, Adventitious rooting, Chlorosis.

Potted seedlings and cuttings of various tree species were submerged to 5-10 cm above the soil level for up to 20 months in order to determine flood tolerance based on leaf conductance (kl), growth, and survival. Flooding induced a decline in kl at soil oxygen diffusion rates of 30, 22, 20, and 15 x 10 to the -8 g/sq cm/min for Prunus persica (L.) Batsch, Halford seedlings (peach), Pyrus communis L. cv. Bartlett (Bart), Pyrus calleryana Decne (Call), and Pyrus betulaefolia Bunge (Bet), respectively. The leaves of some species, particularly Pyrus communis L. cv. Old Home x Farmingdale 97 (OH x F 97), abscised shortly after a decline in kl, yet leaves of most other Pyrus species did not abscise despite months of maintaining a kl near zero. Growth rates were reduced for all fruit tree species except Bet and Call after one month of spring flooding. One month of fall flooding reduced the growth of all fruit tree species the following spring. Bet survived 20 months of continuous submergence; however, only Salix discolor Muhl. (willow) grew well under these conditions. Flooding promoted adventitious rooting of willow, Cydonia oblonga Mill. cv. Provence Ba 29 (quince) and Malus domestica Borkh. cv. MM 106 (apple); anthocyanin pigmentation in leaves of apple and all Pyrus species; leaf chlorosis of quince, apple, and peach; and hypertrophied lenticels on the submerged stems and roots of all species. The tolerance, based upon kl, growth, and survival, was: willow > Bet > Call = quince > Bart > OH x F 97 = Pyrus pyrifolia (Burm.) Nak. (Pyri) = Pyrus ussuriensis Maxim, (Ussuri) = apple > peach. Although the survival of pear rootstocks with and without a 'Bartlett' scion were similar, flooding symptoms often were quite different. (Author's abstract)
W84-05076

MODELING OF DROUGHT RHIZOGENESIS (MODELISATION DE LA RHIZOGENESE DE SECHERESSE),
Paris-11 Univ., Orsay (France).
N. Vartanian, and E. Lesquoy.
Acta Oecologica, Serie Oecologica Generalis, Vol. 5, No. 1, p 3-20, 1984. 8 Fig, 3 Tab, 18 Ref.

Descriptors: *Model studies, *Drought resistance, *Rhizogenesis, Water deficit, Drought rhizigenesis, Soil-water-plant relationship, Random threshold model, Water stress, Data transformation.

In an attempt to model physiological processes involved in adaptive strategy to water deficits, the present study proposes a model to describe the kinetics of drought rhizogenesis in the annual mesophytic species Sinapis alba. This model is based upon the hypothesis of a threshold water potential value in the soil-plant system for the initiation of drought rhizogenesis. It supposes that each plant produces short roots in one or two days and that the variability between plants consists in the randomness of both the date of short roots initiation and the number of short roots produced. A sigmoidal response curve is obtained to describe the expected number of short roots. This curve represents the cumulative distribution function of the random date, multiplied by the expected number of short roots. Data are transformed in order to stabi-

lize the variance and the model is used to compare two irradiance levels and two different genotypes. (Author's abstract)
W84-05285

2J. Erosion and Sedimentation

COHESIVE MATERIAL EROSION BY UNIDIRECTIONAL CURRENT,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
J. W. Kamphuis, and K. R. Hall.
Journal of Hydraulic Engineering, Vol. 109, No. 1, p 49-61, January, 1983. 10 Fig, 1 Tab, 31 Ref.

Descriptors: *Erosion, *Unidirectional flow, Current, Sediment transport, Cohesive soils, Shear stress, Clay, Plasticity, Velocity.

The initiation of motion of consolidated cohesive sediments under a unidirectional flow of clear water was studied. Experiments were performed in a flume-tunnel capable of providing a bed shear stress up to 26 Pa and a velocity of 3.5 m/s, 3 mm above the bed. The variation of critical shear stress with unconfined compressive strength and vane shear strength was linear. The capability of a cohesive soil to resist erosion increases with clay content and plasticity index. The size of the eroded pieces tends to be larger for a soil with a low clay content. The shear stress required to initiate erosion of a cohesive soil increases with consolidation pressure. Once the critical shear stress for a soil is reached, erosion progresses immediately, that is, there is little or no dependence on the previous time history of the flow. Once the initial clay surface has been altered, erosion progresses at a more rapid rate due to an increase in hydrodynamic roughness at the soil surface. A useful experimental facility to study the erosion of cohesive soil has been developed. Soil samples can be preconsolidated up to presssures of 1,000 kPa in a relatively short period of time (2-7 days) using the soil press apparatus. The consolidation range of the soil press plus a maximum erosion velocity 3 mm above the bed of 3.5 m/s in the flume-tunnel enables duplication of most field conditions. Since no general purpose empirical formulations exist to predict the susceptibiltiy of a cohesive soil to erosion, and since prototype underwater tests are expensive, model tests can provide valuable information. A large number of physicochemical factors influence the resistance of a cohesive soil to erosion and, therefore, the model test should simulate the naturally occurring conditions as accurately as possible. This means that in situ soil should be used, the effects of remolding should be determined, and fluid conditions of the prototype should be simulated. (Baker-IVI).
W84-04822

SEDIMENT YIELDS IN COASTAL SOUTHERN CALIFORNIA,
California Inst. of Tech., Pasadena.
B. D. Taylor.
Journal of Hydraulic Engineering, Vol. 109, No. 1, p 71-85, January, 1983. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Sediment yield, *California, *Coastal plains, California shoreline, Sediment discharge, Sediment distribution, Sediment transport, Sedimentary basins, Sedimentation, Deposition, Sedimentation basins, Sand, Erosion, Performance evaluation.

Of the 33,000 sq km of coastal drainage in southern California between Point Conception and the US-Mexico border, approximately four-fifths is erosional according to recent geological history. Ninety-four percent of the erosional area debouchs water and sediment into intermediate depositional areas before reaching the coast, with the remaining 6% (smaller coastal streams) draining directly to the shore line. In southern California the delivery of inland sediments to the coast is important for shoreline stability and the preservation of natural beach areas. During the past several decades, changes in land use and the construction of water conservation and flood control structures have materially affected natural sediment movements and coastal deliveries. To provide a basis for regional sediment management, a study has been undertaken at the California Institute of Technology to quantify natural sediment movements and man's effect on these processes. As a first step in this study, sediment yields from inland areas have been estimated. Results indicate that an annual average of 12 million cu m of sedimentary material are yielded from geologically erosional areas. Of this, 6 million cu m are fine sediments, 5 million cu m are sand, and 0.8 million cu m are coarser than 2 mm. (Murphy-IVI)
W84-04824

UNSTEADY TRANSPORT OF SUSPENDED LOAD AT SMALL CONCENTRATIONS,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
P. N. Lin, J. Huan, and X. Li.
Journal of Hydraulic Engineering, Vol. 109, No. 1, p 86-98, January, 1983. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Sediment transport, *Suspended sediments, *Mathematical models, Estuaries, Routing, Simulation, Particle size, Sediment load, Qiantang estuary, China, Mathematical equations, Performance evaluation.

Sediment carried by tidal flow in many estuaries on erodible coasts may be so fine that suspension becomes the predominant mode of sediment transport. In this case, morphological changes in the estuary are controlled by the unsteady transport of suspended load carried by the currents. Simulation of the unsteady transport of sediment is obviously of great practical value to an estuary of this kind. When suspension is the predominant mode of sediment transport, an expression for the rate of bed changes may be introduced. This equation together with the momentum equation and the continuity equations of water and sediment constitute a set of four equations for four unknowns. Characteristic directions can then be determined without solving a high-degree algebraic equation. The solution is further simplified by adopting a small-concentration approximation. Routing of suspended load with this method is applied to the Qiantang Estuary in Eastern China and rather close simulation has been achieved. (Murphy-IVI)
W84-04825

OVERLAND FLOW, SEDIMENT OUTPUT AND NUTRIENT LOSS FROM CERTAIN FORESTED SITES IN THE CENTRAL HIMALAYA, INDIA,
Kumaun Univ., Naini Tal (India). Dept. of Botany.
P. C. Pathak, A. N. Pandey, and J. S. Singh.
Journal of Hydrology, Vol. 71, No. 3/4, p 239-251, March, 1984. 7 Tab, 25 Ref.

Descriptors: *Surface flow, *Sediment yield, *Nutrient removal, *Forests, *Himalaya, *India, Sediment erosion, Cycling nutrients, Chemistry of precipitation.

The rainfall characteristics and hydrologic responses of the Himalayan forested catchments are relatively unknown. Evaluation of hydrologic components and nutrient fluxes is prerequisite to understanding the watershed ecosystems and management implications. Overland flow, sediment output, input and output of precipitation nutrients were evaluated on six forested sites in the central Himalaya during the 1981 and 1982 monsoon seasons. Overland flow was significantly different across the forests and the months of the rainy season. It was positively related with rainfall quantity and intensity, and was negatively related with tree canopy cover and with ground vegetation cover. Average overland flow was only 0.66% of the total incident rainfall, indicating that these sites are subsurface-flow systems. Sediment output was positively related to overland flow. Rainfall added a significant amount of nutrients to the forests. This extra-system input was greater than loss through overland flow + sediment output. The loss of nutrients from the forested sites was in the order: Mg > C > Ca > K = N = P. (Murphy-IVI)
W84-04862

ENRICHMENT OF TRANSPORTED SEDIMENTS WITH ORGANIC CARBON, NUTRIENTS, AND CLAY,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Y. Avnimelech, and J. R. McHenry.
Soil Science Society of America Journal, Vol. 48, No. 2, p 259-266, March-April, 1984. 22 Fig, 7 Tab, 17 Ref.

Descriptors: *Nutrients, *Organic carbon, *Sediment transport, Nitrogen, Phosphorus, Enrichment ratio, Sediment yield, Sediment-carrying capacity, Sedimentation rates, Erosion, Soil properties, Particle size, Clay.

Much of the nutrient inflow into impoundments is the result of erosion of soil particles on the watershed, together with adsorbed nutrients and their movement from the upland watershed soils. As the detached particles move downstream, they undergo selective size segregation and the nutrients are subject to selective desorption and adsorption between the particles and the water. During transport an enrichment of clay sized particles and the water. During transport an enrichment of clay sized particles within the system occurs as well as that of P, N, and organic C. The ratio of the concentration of any given component in the eroded material system to that in the contributing soils is defined as the enrichment ratio. The selectivity of the erosional and sediment delivery process involved in the transfer of eroded materials from watersheds to lakes or reservoirs is assumed to be proportional to the time, or distance, of travel. This study compares the composition of the eroded material at the onset and at the termination of the erosion, or sedimentation, cycle. From this information insight into the mechanisms affecting the compositional changes along the erosional route may be obtained. Organic carbon, total nitrogen, and total phosphorus concentrations and clay contents in sediments from 41 impoundments or lakes were compared with the equivalent parameters in the soils of the contributing watersheds. The enrichment ratio of a given component (S/S sub o the concentration of the component in the eroded material divided by its concentration in the soil) was theoretically predicted to be: S/S sub o = 1/S sub o x L, where L is a limiting value representing a stable level of this component in the erosion sequence. The measured enrichment ratios for organic C and total N were in good agreement with the theoretical model, the stable levels being 24 and 1.7 g/kg for organic C and total N. No such agreement was found for P and clay enrichment ratios, possibly due to the effect of the variable flow conditions on the selective erosion of these compounds. (Author's abstract)
W84-04874

SOIL LOSS REDUCTIONS FROM CONSERVATION TILLAGE PRACTICES,
Universidade Federal do Rio Grande do Sul, Porto Alegre (Brazil).
N. P. Cogo, W. C. Moldenhauer, and G. R. Foster.
Soil Science Society of America Journal, Vol. 48, No. 2, p 368-373, March-April, 1984. 7 Tab, 18 Ref.

Descriptors: *Soil erosion, *Conservation tillage, *Soil management, Erosion control, Mulches, Martinsville loam, Hapludalfs, Russell silt loam soil, Simulated rainfall, Soil conservation.

Conservation tillage practices are the least costly and least disruptive of the presently available erosion control systems, and in many cases lead to a very significant saving in energy and other expenses. Soil loss reductions by residue cover (mulch) under field conditions were verified by deriving a mulch factor for no-till, chisel plowing plus disking, and spring sweep tillage using anchored and unanchored corn (Zea mays L.) and soybean (Glycine max (L.) Merr.) residues on a 4.5% slope 10.5 m long on Russell silt loam soil. A mulch factor was also derived for sweep tillage using anchored wheat residue on a 6.5% slope Martinsville loam soil, for simulated slope lengths of 35, 60, 85, 110, and 135 m. Both soils are Typic Hapludalfs. The studies were conducted using sim-

ulated rainfall and field plots. A crop residue mulch was relatively more effective than roughness alone in reducing soil loss on smoother soil surfaces and on the longer slopes. Corn residue was more effective in reducing erosion than soybean residue, and residues partially incorporated into the soil were more effective in reducing soil loss than residues loose on the surface. The findings showed that the b-value in the mulch factor (Fm)-% residue cover (M) equation Fm = e to the negative bM power varied appreciably depending on roughness, and type and incorporation of the residue. (Murphy-IVI)
W84-04878

SEDIMENTATION CLOSE TO A NEAR VERTICAL ROCKY WALL IN BALSFJORDEN, NORTHERN NORWAY,
Tromsoe Univ. (Norway). Dept. of Marine Biology.
B. Gulliksen.
Sarsia, Vol. 67, No. 1, p 21-27, 1982. 9 Fig, 32 Ref.

Descriptors: *Sedimentation, *Vertical wall, *Geomorphology, *Galsfjorden, *Norway, Sedimentation rates, Sediment yield, Ecological effects, Phytoplankton blooms, Carbon, Nitrogen, Nutrients.

The rate of sedimentation and the amount of sediment accumulating on the bottom are amoung physical factors of importance for the distribution and abundance of marine benthic organisms. Rates of sedimentation were investigated using collecting jars. Jars suspended at 5, 10, 20, and 30 m depth from October 1976 to November 1977 indicated an increasing sedimentation with depth. The rate of sedimentation exhibited seasonal fluctuations with highest values during spring and summer. At 5 and 10 m depth, maxima in spring and summer corresponded with phytoplankton blooms while maxima at 20 and 30 m were more spread through the summer months. Sedimentation rates and carbon/nitrogen (C/N) ratios were calculated. The mean C/N ratios of sedimented material after acidification were usually below 10:1 from April to October/November in 1977. The highest values of C/N were recorded in February and the early part of March. The amount of resuspended material collected in the jars decreased with distance from the rocky wall. (Murphy-IVI)
W84-04903

PARTICLE SIZE DISTRIBUTION AND NATURAL COAGULATION IN LAKE ZURICH (PARTIKELGROSSENVERTEILUNG UND NATURLICHE KOAGULATION IM ZURICHSEE),
Institut fuer Gewaesserschutz und Wassertechnologie, Zurich (Switzerland).
For primary bibliographic entry see Field 2F.
W84-04919

TIMBER HARVESTING AND FLOODING,
Plum Creek Timber Co., Inc., Missoula, MT.
For primary bibliographic entry see Field 4C.
W84-05056

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS; 1. A STOCHASTIC SEDIMENT STORAGE MODEL,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 8A.
W84-05127

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS: 2. DETERMINISTIC MODEL FOR THE SEDIMENT DEPOSITION PROCESS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 8A.
W84-05128

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS; 3. APPLICATION OF THE TWO MODELS IN CONJUNCTION,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
For primary bibliographic entry see Field 8A.
W84-05129

EFFECT OF EROSION ON SOLUTE PICKUP FROM MANCOS SHALE HILLSLOPES, COLORADO, U.S.A.,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Geography.
J. B. Laronne, and H. W. Shen.
Journal of Hydrology, Vol. 59, No. 1-2, p 189-207, October, 1982. 9 Fig, 3 Tab, 30 Ref.

Descriptors: *Soil erosion, *Solute transport, *Mancos Shale, *Colorado, Shales, Runoff, Rainfall-runoff relationships, Salinity, Surface runoff, Sediment yield, Rill erosion.

Sediment concentration has been shown to be statistically related to solute concentration. A causal relationship is demonstrated between these water quality variables. Solute concentration, which for a constant discharge is linearly related to solute production, increases with increases in sediment yield during rilling and rill entrenchment due to dissolution of transported sediment particles. Moreover, solute release increased as the power per unit width of surface area increased, thereby causally explaining the high correlation between runoff salinity and slope inclination. The regression between these two variables may be used as a tool to assess salinity hazard. The proportions of solute yield derived entirely from contact with the soil surface or from dissolution of transported sediment have not been determined. It is assumed that a significantly larger proportion of solute yield from Mancos Shale hillslopes originates from transported sediment than that demonstrated herein. Direct runoff rather than rainfall induced runoff was generated on the studied hillslopes. (Baker-IVI)
W84-05135

ASSESSMENT OF 210PB DATA FROM SITES WITH VARYING SEDIMENT ACCUMULATION RATES,
Liverpool Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
P. G. Appleby, and F. Oldfield.
Hydrobiologia, Vol. 103, p 29-35, July, 1983. 3 Fig, 1 Tab, 19 Ref.

Descriptors: *Paleolimnology, *Radioactive dating, Dating, Lead, Sediments, Lake sediments, Sedimentation.

The principle assumptions used in Pb-210 chronology are outlined and techniques are presented for assessing the consistency of data with these assumptions. No single model exists that will give a reliable Pb-210 chronology in all cases, and each data set must be evaluated independently for consistency with one or another of the dating models. A tentative procedure for evaluating data is given. For linear profiles, all models give the same chronology. For non-linear profiles, if the Pb-210 residuals are comparable with the known atmospheric flux, or with the Pb-210 residuals or nearby cores, the constant rate supply model would appear to be applicable. If the Pb-210 residuals do not satisfy the requirements of the constant rate supply model, but there is independent evidence that the primary sediment accumulation rate has been constant, the constant initial concentration model will be applicable. This case may occur in situations where sediment focusing takes place. If the Pb-210 residuals do not satisfy the requirements of either model, a Pb-210 chronology cannot be reliably established. Pb-210 dates calculated in these circumstances frequently have been in conflict with independent dating evidence. (Baker-IVI)
W84-05208

MINERAL MAGNETIC STUDIES OF LAKE SEDIMENTS,
Liverpool Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W84-05209

CHANGING PATTERNS OF SEDIMENT ACCUMULATION IN A SMALL LAKE IN SCANIA, SOUTHERN SWEDEN,
Coventry (Lanchester) Polytechnic (England). Dept. of Geography.
For primary bibliographic entry see Field 2H.
W84-05210

USE OF X-RAY RADIOGRAPHIC METHODS IN STUDYING SEDIMENTARY PROPERTIES AND RATES OF SEDIMENT ACCUMULATION,
Uppsala Univ. (Sweden). Naturgeografiska Inst.
V. Axelsson.
Hydrobiologia, Vol. 103, p 65-69, July, 1983. 3 Fig, 6 Ref.

Descriptors: *X-rays, *Sedimentary structures, *Sedimentation, Laminations, Sediment distribution, Lake sediments, Bays, Sweden.

X-ray radiographs of unextruded sediment cores are used for the documentation and the interpretation of primary and secondary sedimentary structures, and for the correlation of synchronous laminations between different cores. The vertical variation in bulk density, water content and void ratio, and the increase of solids with increasing sediment depth are calculated from the recorded film density along the radiographs. The X-ray radiographic technique for the study of sedimentary properties is fast and non-destructive. The technique is especially valuable when studying the uppermost part of the sediment cover and the process of sediment redistribution and sediment accumulation. Studies are being undertaken in several Swedish lakes and coastal bays, where mono- and stereoradiographs are being used to classify bottom and sediment types, to interpret changes in the depositional environment, and to calculate past and present rates of sediment accumulation. (Author's abstract)
W84-05211

TRACE ELEMENT ASSOCIATIONS AS INDICATORS OF SEDIMENT ACCUMULATION IN LAKES,
Akademiya Nauk SSSR, Leningrad. Inst. Ozerovedeniya.
For primary bibliographic entry see Field 2H.
W84-05212

DIATOM AND CHRYSOPHYTE RELICT ASSEMBLAGES IN THE SEDIMENTS OF BLELHAM TARN IN THE ENGLISH LAKE DISTRICT,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W84-05217

MATHEMATICAL MODEL FOR SEDIMENT TRANSPORT OVER BEDFORMS (MATHEMATISCHES MODELL FUR DEN FESTSTOFFTRANSPORT UBER SOHLFORMEN),
Bundesanstalt fuer Wasserbau, Hamburg (Germany, F.R.). Abt. Kuste.
W. Puls.
Wasserwirtschaft, Vol. 73, No. 5, p 143-148, May, 1983. 6 Fig, 26 Ref.

Descriptors: *Sediment transport, *Sedimentation, *Sedimentary structures, Sediment grading, Sediment-carrying capacity, Ripple marks, Sedimentary basins, Sediment erosion, Physical properties, Water currents, Turbidity currents, Rip currents, Flow characteristics.

The small-scale sediment transport over transverse bedforms (ripples, dunes) is calculated by a numerical model. This calculation is based on the turbulent flow which is also computed numerically. The model effectively determines sediment transport mechanisms over ripples, dunes and level bed-

forms. The model is mainly used for the investigation of the physics of bedform mechanics. (Murphy-IVI)
W84-05241

BEGINNING OF EROSION AT SUBMERGED FLEXIBLE ROUGHNESS ELEMENTS (UBER DEN EROSIONSBEGINN BEI DER UBERSTROMUNG VON FLEXIBLEN RAUHEITSELEMENTEN),
Emschergenossenschaft, Essen (Germany, F.R.).
B. Haber.
Wasserwirtschaft, Vol. 73, No. 7/8, p 231-239, 1983. 7 Fig, 1 Ref.

Descriptors: *Soil erosion, *Overland flow, Roughness, Mathematical equations, Filter crops, Sediment deposition.

A method for the determination of erosion onset applicable for flow over artificial flexible roughness elements and natural crops was elaborated. Surface runoff erosion protection uses grasses to cover the runoff area, and sediments are left behind in heavily grassed areas. The velocity and roughness coefficients are major factors in erosion. Erosion equations were developed using gravitational complements: turbulence, force, velocity and roughness. (Moore-IVI)
W84-05248

PARTICULATE MATTER IN NATURAL WATERS (KOLLIDALE WASSERINHALTSSTOFFE IN NATURLICHEN GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. H. Hahn.
Wasserwirtschaft, Vol. 73, No. 11, p 434-441, 1983. 15 Fig, 33 Ref.

Descriptors: *Particulate matter, *Natural waters, *Sediment transport, Suspended solids, Dissolved solids, Metal oxides, Clays, Biocolloids.

Particulate matter represents a large fraction of all substances transported in a natural water. It is also responsible for the transport of many dissolved substances. For this reason a concept for the description of the transport of suspended solids has been developed. In laboratory investigations the aggregation of metal oxides, clays and biocolloids has been studied. With this data a computational routine was developed to describe the distribution in time and space of particulate matter in free flowing and partly impounded rivers. In-situ observations confirm the adequateness of the developed methodology. (Author's abstract)
W84-05260

INFLUENCE OF SECONDARY FLOW UPON BED FORMATION AND SEDIMENT TRANSPORT IN OPEN CHANNELS, (EINFLUSS DER SEKUNDARSTROMUNG AUF SOHLAUSBILDUNG UND SEDIMENTTRANSPORTVORGANGE IN OFFENEN GERINNEN),
C. Zimmermann.
Wasserwirtschaft, Vol 73, No. 11, p 447-452, November, 1983. 7 Fig, 15 Ref.

Descriptors: *Sediment transport, *Open channels, *Secondary flow, Alluvial channels, Model studies, Channel morphology, Scour, Channel curvature.

From investigations of the parameters determining bed formation and sediment transport in alluvial channel bends which were performed in circular laboratory flumes, analytical models could be developed for predictions of the cross sections of channel bends and sediment motion. These models have been further developed and are now the basis for technical measures to predict endangered natural channel bends. A report is also given on formation and dynamics of significant large scour holes in channel bends. It has been observed that sediment transport rates increase significantly with decreasing channel curvature, compared with results from a straight flume with the same flow conditions. (Author's abstract)
W84-05262

JET EROSION (STRAHLEROSION),
Stuttgart Univ. (Germany, F.R.).
B. Westrich, and H. Kobus.
Wasserwirtschaft, Vol. 73, No. 11, p 453-458, November, 1983. 27 Fig, 7 Ref.

Descriptors: *Jet erosion, *Erosion, Scour, Sediment erosion, Hydrodynamics, Flow velocity, Erosion rate.

Submerged jets impinging on a movable sediment bed have a strong scouring capacity. The scouring effect depends on the hydrodynamic wall pressure at the impinging region and the permeability of the bed material. Two characteristic scour forms with different erosion and transport pattern can be observed. Periodical jet velocity fluctuations improve the flow conditions at the bottom and enhance the scouring rate. (Author's abstract)
W84-05263

INVESTIGATION OF SUSPENDED SEDIMENT RATING CURVES IN WESTERN AND NORTHERN GREECE,
Athens Univ. (Greece). Dept. of Civil Engineering.
M. Mimikou.
Hydrological Sciences Journal, Vol. 27, No. 3, p 369-383, September, 1982. 9 Fig, 7 Tab, 11 Ref.

Descriptors: *Suspended sediments, *Flow discharge, *Greece, Sediment load, Seasonal variation, Sediment yield, Erosivity, Soil erosion, Rainfall distribution.

The suspended sediment rating curves for six stations on four rivers in western and northern Greece are investigated. For each station the suspended sediment load is a power function of the water discharge, which may be distinguished according to wet and dry seasons; the latter yields higher sediment loads for a given discharge than the former. This is due to the higher erosivity of dry season rainfall compared to wet season rainfall producing the same runoff. All rating curve exponents b lie in the range 2.5-3.5 for the wet and 2.0-3.0 for the dry season and are related to the constants a of the curves by empirical equations. The variation in a and b is explained in terms of the annual precipitation and area of the basin, the hypsometric fall, the main channel length, and the average bedslope of the river from the basin divide to the station, through empirical relationships, which also permit the prediction of rating curves for ungauged basins. (Author's abstract)
W84-05293

EFFECT OF RAINDROP IMPACT AND SLOPE LENGTH ON SEDIMENT CONCENTRATION OF RUNOFF,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
J. V. Mannering, and W. C. Moldenhauer.
Proceedings of the Indiana Academy of Sciences, Vol. 92, p. 463-467, 1982. 2 Tab, 8 Ref.

Descriptors: *Rainfall-runoff relationships, *Erosion, *Sediment transport, Rainfall intensity, Rainfall impact, Simulated rainfall, Black Creek Watershed, Indiana, Erosion control.

The effect of raindrop impact and surface runoff in detaching and transporting soil material was determined. This is important in order to develop land treatment measures that will effectively reduce sediment yields from agricultural watersheds. The study was made at the EPA-supported Black Creek Watershed Sediment Study located in Allen County, Indiana. The results of simulated rainfall and inflow studies on four soils (Haskins loam, Nappanee clay loam, Hoytville silty clay, and Morley clay loam) show rainfall energy to be the major factor affecting sediment concentration of runoff from agricultural soils in a seedbed condition. Sediment concentration of rainfall-induced runoff ranged from 7 to 12 times that of inflow-induced runoff for all the soils. In the study, doubling or tripling the selected inflow to simulate increased slope length had little influence on sediment concentration. However, slope steepness did influence sediment concentration. On the test site having a 5.1% slope, sediment concentrations approximately three times those from the other three nearly level test sites occurred whether runoff was rainfall-induced, inflow induced, or a combination of both. These results demonstrate again the necessity of protecting the soil surface from raindrop impact in order to effectively reduce sediment concentrations of runoff which will, in turn, maintain soil productivity and enhance water quality. (Baker-IVI)
W84-05311

MOLECULAR DYNAMICS AND STATISTICAL MECHANICS OF WATER NEAR AN UNCHARGED SILICATE SURFACE,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W84-05334

LOCAL SCOUR AROUND SPUR-DIKES,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Journal of Hydrology, Vol. 60, No. 1-4, p 123-140, January, 1983. 13 Fig, 20 Ref.

Descriptors: *Scour, *Spur dikes, Dikes, Spurs, Flow, Sediment, Mathematical equations, Design criteria, Froude Number.

Experimental investigations were conducted to study the effects of upstream flow conditions, sediment characteristics, and spur-dike's geometry on the maximum scour depth and scour pattern around a spur-dike. Dimensional analyses to find different nondimensional terms affecting the phenomenon were obtained and verified with the help of the experimental data. The maximum depth of scour is significantly affected by the channel's Froude number and the opening ratio at the spur-dike's location. The derived empirical formula, for the maximum depth of scour, is identical in form to the regime equations of Lacey and Blench. The formula gave a good correlation coefficient which may be used to predict the maximum scour depth for conditions similar to those covered in this study. The depth of scour progresses linearly with the logarithm of time during the development of the hole. The greater the ratio of the disturbing force to the resisting force, the greater the rate of scour. The experiments indicate that the limiting extent of scour is reached when the velocity has been reduced to its critical value due to the enlargement of the scoured section. The continuous removal of the material deposited downstream of the scour hole provides proper simulation of prototype conditions and has the advantage of considerably saving experimental run time. The clear water condition, under which the experiments were conducted, yields deeper and larger scour holes, which confirms the fact that this condition is more critical regarding design criteria. (Baker-IVI)
W84-05352

MODELLING SEDIMENT TRANSPORT AS A MOVING WAVE - THE TRANSFER AND DEPOSITION OF MINING WASTE,
Australian National Univ., Canberra. North Australia Research Unit.
G. Pickup, R. J. Higgins, and I. Grant.
Journal of Hydrology, Vol. 60, No. 1-4, p 281-301, January, 1983. 5 Fig, 1 Tab, 17 Ref.

Descriptors: *Mine wastes, *Sediment transport, Model studies, Waves, Velocity, Papua, New Guinea, Kawerong River, Bougainville Island.

The movement of slugs of bedload from a discrete input point down a river has proved difficult to model using conventional finite-difference formulations of equations of motion. A model is proposed which makes explicit allowance for the mean sediment velocity and, through a dispersion coefficient, the distribution of sediment velocity about the mean. A second comparative model uses the normal mass conservation or sediment transport continuity approach. The models have been tested over a 43 month period using data from seven monitored cross-sections of the Kawerong River on Bougainville Island, Papua New Guinea, a

system which receives waste from a large copper mine. The dispersion model performs considerably better than the mass conservation model. While the overall volume of sediment transported is of the correct order of magnitude, the model is not accurate enough to predict the basic pattern of deposition through time. It also fails to reproduce the pattern of downstream variations in deposition and on many sections shows rapid fluctuations which did not occur. The dispersion model seems to damp out these fluctuations and produces a more realistic sequence of river behavior. In an operational context, the information usually required is the height of deposition rather than its area. Even at its worst, the dispersion model gives few heights with errors of more than 3 m and for most of the time, the errors are less than 1 m which is adequate for most practical applications. (Baker-IVI)
W84-05362

2K. Chemical Processes

INFLUENCE OF NATURAL ORGANIC MATTER ON THE ADSORPTION PROPERTIES OF MINERAL PARTICLES IN LAKE WATER,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 2H.
W84-04904

EQUILIBRIUM APPROACHES TO NATURAL WATER SYSTEMS - PART 2; IN SITU DETERMINATION OF THE EQUILIBRIA H2CO3 EQUILIBRIUM HCO3(-) + H(+) IN THE TEMPERATURE RANGE 4-18 DEGREES C IN A LAKE WATER OF 1.6 MM IONIC STRENGTH,
Umea Univ. (Sweden). Dept. of Inorganic Chemistry.
For primary bibliographic entry see Field 2H.
W84-04918

INFLUENCE OF METAL COMPOUNDS ON FULVIC ACID/MOLYBDENIUM BLUE REACTIVE PHOSPHATE ASSOCIATIONS,
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W84-05004

PHOTOCHEMICAL GENERATION OF HYDROGEN PEROXIDE IN NATURAL WATERS,
California Univ., Davis. Dept. of Environmental Toxicology.
W. M. Draper, and D. G. Crosby.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 121-126, January, 1983. 4 Fig, 5 Tab, 25 Ref.

Descriptors: *Hydrogen peroxide, *Photochemical reactions, *Natural waters, Tryptophan, Solar radiation, Photodecomposition, Oxidants, Eutrophication, Tyrosine, Phenols, Analines.

The photochemical formation of hydrogen peroxide in tryptophan solutions and natural waters was monitored by a sensitive spectrophotometric assay. Peroxide was characterized by ion exchange properties and mobility via thin-layer chromatography. Tryptophan photodecomposed in sunlight or near ultraviolet light (gamma > 283 nm) with the formation of uncharacterized, acidic photoproducts and hydrogen peroxide: other oxidants (i.e. organic peroxides) were not detected in tryptophan photolysis mixtures. After brief exposure to sunlight, hydrogen peroxide in natural waters varied from below the detection limit (1.5 micro M) to 6.8 micro M; in highly eutrophic samples peroxide was formed in excess of 30 micro M. A humic acid soil extract, tyrosine, and several aromatic compounds including substituted phenols and anilines also generated stable photochemical oxidants suggesting that many compounds may serve as sources for hydrogen peroxide in natural waters. (Author's abstract)
W84-05175

EXCHANGE PROCESSES AT THE SURFACE OF WATER (AUSTAUSCHVORGANGE AN DER OBERFLACHE VON GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
E. J. Plate, and R. Friedrich.
Wasserwirtschaft, Vol. 73, No. 11, p 427-433, November, 1983. 10 Fig, 21 Ref.

Descriptors: *Surface water, *Air-water interfaces, *Chemical properties, *Physical properties, Turbulent flow, Turbidity flow, Turbidity currents, Turbidity, Surface tension, Heat balance, Wave propagation, Wind-driven currents.

The physical and chemical characteristics of water and air are significantly changed by wind induced exchange processes. The interaction of wind and water generates waves and turbulence in the boundary layers on both sides of the water surface. The turbulence influences the transport of heat, vapor, and gases through the interface between water and air. Laboratory investigations concerning such problems led to some basic results, particularly with regard to wind on flowing water. (Author's abstract)
W84-05259

STUDY OF THE CYCLING OF MANGANESE AND OTHER ELEMENTS IN A SEASONALLY ANOXIC LAKE, ROSTHERNE MERE, U.K.,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2H.
W84-05319

SOIL-WATER RESIDENCE TIME AND SOLUTE UPTAKE. 1. DYE TRACING AND RAINFALL EVENTS,
Sheffield Univ. (England). Dept. of Geography.
S. T. Trudgill, A. M. Pickles, K. R. J. Smettem, and R .W. Crabtree.
Journal of Hydrology, Vol. 60, No. 1-4, p 257-279, January, 1983. 11 Fig, 3 Tab, 54 Ref.

Descriptors: *Rainfall, *Infiltration, Soil water, Tracers, Solubility.

Fluorescent dyes have been used to label rainfall infiltrating into a well-structured calcareous woodland soil in situ. Soil-water outflow was monitored using throughflow troughs. The occurrence of dye output from the soil could not be totally predicted by the use of a simple storage model but was related to the occurrence of intense-rainfall events equal to or greater than 3 mm/hr lasting for at least 2 hr. Precise specification of intensity conditions is not simple because of canopy interception and in storm variations in intensity. Sustained intense rainfall leads to output and additional work should be able to more accurately quantify the threshold conditions. In terms of actual physical conditions, details of canopy interception, soil dye pathways, soil-moisture variations and incremental movement through the soil during successive storms prior to final output are important factors for further study. Dye studies may be used in the field to identify mobile soil water at an output point, using short trace distances, but not for quantitative recovery analysis. (Baker-IVI)
W84-05361

2L. Estuaries

UNSTEADY TRANSPORT OF SUSPENDED LOAD AT SMALL CONCENTRATIONS,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 2J.
W84-04825

REGIONAL STEADY INTERFACE BETWEEN FRESH WATER AND SALT WATER IN A COASTAL AQUIFER,
Ehime Univ., Matsuyama (Japan). Dept. of Applied Physics.
Y. Kishi, Y. Fukuo, T. Kakinuma, and M. Ifuku.
Journal of Hydrology, Vol. 58, No. 1-2, p 63-81, August, 1982. 11 Fig, 18 Ref.

Descriptors: *Saline water intrusion, *Saline-freshwater interfaces, *Coastal aquifer, Model studies, Hydrologic models, Hydraulic conductivity, Naka River estuary, Tokushima Prefecture, Japan.

The phenomenon of seawater intrusion into groundwater has often been observed in coastal regions. The shape and position or the movement of the interface may be closely related to the inflow or height of groundwater at the upstream boundary, the amount of groundwater pumped and the amount of the infiltration by precipitation. A theoretical model is presented which is useful for determining the regional steady interface between fresh water and salt water under the appropriate boundary conditions for both confined and unconfined aquifers. This model is then applied to the confined groundwater in the estuary of the Naka River, Tokushima Prefecture, Japan, and the phenomenon of the seawater intrusion into the aquifer is analyzed. Boundary conditions of the confined aquifer and the parameters necessary for analysis are determined from the data. Calculations using a finite-element method are carried out in various cases, by changing the inflow SR or the total pumping amount Q of the groundwater in this alluvial plain. It is found that the region where salt water is intruding expands rapidly inland when SR approached Q and vice versa. It is also found that the distributions of chloride ion concentration in groundwater calculated by this model with a simplified assumption are in fairly good agreement with the results observed in deep wells. (Murphy-IVI)
W84-04839

EFFECT OF NON-DARCY FLOW ON COMPUTING SEAWATER INTRUSION LENGTHS,
Centre for Water Resources Development and Management, Calicut (India).
P. Basak, and S. P. Rajagopalan.
Journal of Hydrology, Vol. 58, No. 1-2, p 83-87, August, 1982. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Groundwater movement, *Saline water intrusion, Coastal aquifers, Darcy's Law, Saline water, Water quality control, Aquifers.

An analytical solution for the seawater intrusion length in coastal aquifers under steady state under non-Darcy flow is presented. The length of seawater intrusion increased as the flow deviated more and more from Darcian linearity. This implies that there will be an underestimation of the seawater intrusion length if the Darcian condition of flow is assumed while in the actual case this may not hold true. It is believed that the analysis presented and the results reported would be of use in correctly computing the seawater intrusion length in coastal aquifers where non-Darcy flow is likely to occur. (Baker-IVI)
W84-04840

LONGEVITY OF ALGAL INHIBITION AFTER CHLORINATION OF ESTUARINE WATER,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
J. G. Sanders.
Environmental Science and Technology, Vol. 18, No. 5, p 383-385, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Estuaries, *Chlorination, *Inhibition, *Algae, Water pollution effects, Chlorine, Bioaccumulation, Copper, Biocontrol, Chemical properties.

Estuarine water was chlorinated to 10 mg/L, aged 10-35 days, and then used as a growth medium for three phytoplankton species. Total residual chlorine compounds were undetectable in the chlorinated water; however, two species would not grow even after the water had been aged 35 days. A more resistant species grew in chlorinated water aged 23 or 35 days but would not grow in water aged 10 days. All three species grew well in the same water that had not been chlorinated. The degree of chlorination as well as the aging time was important in determining cell growth. In addition, algal resistance to trace metal (Cu) toxicity was reduced, possibly due to increased activity of

the free Cu ion. The quantity of organic carbon oxidized during the degradation of chlorine residuals is sufficient to destroy the Cu binding capacity of estuarine waters. (Author's abstract)
W84-04891

COMPARATIVE ECOLOGY OF NEKTON RESIDING IN A TIDAL CREEK AND ADJACENT SEAGRASS MEADOW: COMMUNITY COMPOSITION AND STRUCTURE,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
M. P. Weinstein, and H. A. Brooks.
Marine Ecology - Progress Series, Vol. 12, No. 1, p 15-27, April, 1978. 7 Fig, 4 Tab, 44 Ref. EPA grant R 808707.

Descriptors: *Comparison studies, *Nekton ecology, *Estuaries, *Species composition, Vaucluse Shores, Virginia.

A structural analysis of the nekton communities occupying a tidal creek and adjacent seagrass meadow at Vaucluse Shores, Virginia (Delmarva Peninsula, USA) is presented along with a comparison of the relative value of each habit to the early life stages of marine and estuarine species. Seagrass meadows were characterized by significantly greater richness and diversity of constituent taxa; both areas, nevertheless, contained mixtures of habitat specialists and wide-ranging (ubiquitous) species that displayed no areal preferences. Except for a few resident forms, much of the nekton community in the grassbed was comprised of less abundant 'southern' species that entered the Chesapeake Bay in late summer and fall. Reciprocal averaging and numerical classification procedures applied to pooled station collections further indicated the clinical nature of species distributions among habitats, but also clearly demonstrated several microhabitat associations for either the Zostera marina or Ruppia maritima portions of the grassbed. The sciaenid, Leiosotomus xanthurus dominated the nekton in both habitats, with > 80% of all individuals but were nearly 4 times as abundant in the tidal creek. Abundance distribution and length frequency analyses for this species indicated that the marsh is the preferred habitat but also that larger individuals in the population continuously 'bled off' into downstream areas. Two other species of regional importance, Callinectes sapidus and paralichthys dentatus, also utilized both habitats extensively. Late in summer and early fall, juveniles of both species were more abundant in the grassbed, whereas earlier in the year, they were randomly dispersed. The apparently limited dependence on both the grassbed and tidal creek by the young of local taxa is strikingly different when compared to similar habitats at lower latitudes. In light of the differences established between these habitats and their utilization by different species, an attempt is made to identify potentially important determinants of community structure and relate these to the success of individual populations in both areas. (Murphy-IVI)
W84-04897

INFLUENCE OF RIVER-OCEAN PLUMES UPON BACTERIOPLANKTON PRODUCTION OF THE STRAIT OF GEORGIA, BRITISH COLUMBIA,
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
L. J. Albright.
Marine Ecology - Progress Series, Vol. 12, No. 2, p 107-113, May, 1983. 6 Fig, 22 Ref.

Descriptors: *River-ocean plumes, *Ecological effects, *Bacterioplankton, *Strait of Georgia, *British Columbia, Aquatic productivity, Salinity, Estuaries, Fraser River, Squamish River, Homathko River, Southgate River, Plumes, Microenvironment.

The Strait of Georgia which has a calculated volume of ca. 1025 cu km of estuarine water, annually receives about 145 cu km of runoff water, mainly from rivers, creeks and streams. Stimulation in bacterioplankton glucose heterotrophic activities and productivities occurs when river water (Fraser, Squamish and Homathko-Southgate rivers) enter the saline surface waters of the Strait of Georgia, British Columbia, Canada. As the lower salinity water of the Fraser plume (ca. half of the fresh water flow into this Strait comes from this river) mixes into adjacent surface waters of the Strait, bacterioplankton production remains significant till the salinity exceeds ca. 20% S. Since lower salinity water (i.e. < or = ca. 20% S) from river plumes covers extensive areas of the Strait of Georgia during the annual freshet (ca. April to July) there is a significant annual bacterial contribution to total microbial production within this estuarine ecosystem. (Murphy-IVI)
W84-04898

PREFERENTIAL INGESTION OF ORGANIC MATERIAL BY THE AMERICAN OYSTER CRASSOSTREA VIRGINICA,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
R. I. E. Newell, and S. J. Jordan.
Marine Ecology - Progress Series, Vol. 13, No. 1, p 47-53, July, 1983. 4 Fig, 36 Ref. NOAA grant RF 14.

Descriptors: *Preferential ingestion, *Organic matter, *American oyster, Biofiltration, Biofilters, Food habits, Diets.

Using an artificial diet, composed of silt < 32 micro m in diameter and the algal Tetraselmis suecica, it was demonstrated that the oyster Crassostrea virginica could significantly reduce the concentration of algae voided in the pseudofeces (measured as extracted chlorophyll pigment) by over 50%, compared to levels in the food. More importantly, it was also shown that for C. virginica fed natural seston at concentrations between 4 to 20 mg/l, the proportion of energy, carbon and nitrogen voided in the pseudofeces could also be reduced significantly compared to that in the food. As the organic material in natural seston is from a wide range of sources - e.g. phytoplankton of different sizes, bacteria, detritus particles, etc. - these results indicate that C. virginica has a well developed ability to ingest preferentially various types of organic material and to reject other particles as pseudofeces. This discriminatory mechanism must be able to operate on individual particles despite the fact that they are bound in viscous mucus. We hypothesize (based on literature information for the properties of molluskan mucus) that the viscosity of the mucus in which the food particles are entrapped may be significantly reduced by the ciliary action on the ridged surfaces of the opposed labial palps. This reduced viscosity mucus is possibly moved to the free edge of the palp where, with a cessation of the mechanical stimulation, it regains its original viscosity. The individual particles may then be subject to chemical testing by chemoreceptors which determine whether a particle is moved over the palp ridge to the mouth or is admitted to the deep rejection tracts. These rejected particles move to the free edge of the palps where they are re-incorporated in the mucus and rejected as pseudofeces. (Author's abstract)
W84-04900

TIDAL CORRECTIONS IN HYDROGRAPHIC SURVEYING,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
C. Blair.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 1, p 31-40, February, 1983. 5 Fig, 7 Ref.

Descriptors: *Hydrographs, *Tidal effects, Errors, Surveys, Water depth, Hydrography, Estuaries.

Depth errors may occur in hydrographic surveys if tidal corrections are determined from water surface heights measured at points distant from the immediate vicinity of the soundings. Use of predicted rather than measured heights is another potential cause of error. Errors are presented for a hypothetical calculation of dredging pay quantities. Procedures for reducing errors are suggested, and methods of measuring tide height described. The tidal correction to hydrographic soundings is a function both of time and of location. For greatest accuracy the surveyor must determine the geodetic elevation of the water surface in the immediate vicinity of each sounding. In selecting locations of tide gages for a survey, engineering judgement and knowledge of estuarine and oceanographic principles are required in balancing accuracy requirements against cost. Only as a last resort should corrections be based upon predicted astronomical tide heights; actual measurement is needed to detect variations caused by meteorological conditions. Tide gages work on a variety of physical principles and span a wide range of complexity, flexibility, accuracy, and cost. The choice of gage type depends on the requirements of the particular survey under consideration. (Baker-IVI)
W84-04961

TWO-DIMENSIONAL BRANCHING SALT INTRUSION MODEL,
Argonne National Lab., IL. Energy and Environmental Systems Div.
D.-P. Wang.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 1, p 103-112, February, 1983. 7 Fig, 7 Ref, 3 Append. Maryland Dept. of Natural Resources contracts P40-78-04, P62-80-04.

Descriptors: *Saline water intrusion, *Model studies, *Chesapeake Bay, *Susquehanna River, *York River, Bays, Rivers, Salinity, Low flow, Simulation, Mixing, Gravitational circulation.

A two-dimensional branching model is developed to simulate salinity distribution in complex estuaries. The model is applied to a one-month salinity study in the Chesapeake Bay during a period of low freshwater discharges from the Susquehanna River. The high salinity water is advected upstream in the lower layer by the density-driven (gravitational) circulation. The lower layer water is mixed upward, resulting in a salinity increase through the water column. The total salinity increase and the extent of salt intrusion depends on the parameterization of vertical mixing and friction. For instance, stronger mixing across the halocline will significantly increase the total salinity. The effect of the longitudinal mixing can be completely neglected. Sensitivity analysis with a flow reduction in the Susquehanna River suggests significant increase of total salinity in the upper bay. The flow reduction will also enhance bottom water intrusion over the entire bay. This latter effect is caused by the internal pressure (density) adjustment. A dramatic example of the rapid bottom water intrusion was found in the York River during the relaxation of a high-flow episode. The use of a two-dimensional model correctly simulates the key features in salt intrusion. The long-term simulation will also eliminate the aliasing of verification data caused by short-period atmospheric forcing and tidal effects. (Baker-IVI)
W84-04963

DEGRADATION OF AMINO ACIDS AT A SIMULATED WATER-SEDIMENT INTERFACE OF A MEDITERRANEAN LAGOON ENVIRONMENT, GOLFE DU LION (DEGRADATION D'ACIDES AMINES A L'INTERFACE EAU-SEDIMENT RECONSTITUE D'UNE LAGUNE MEDITERRANEENNE (GOLFE DU LION)),
Endoume Marine Station and Oceanography Centre, Marseille (France).
R. Daumas, F. Gadel, G. Cahet, and A. Dinet.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 2, p 201-213, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Water-sediment interfaces, *Lagoons, *Amino acids, *Chemical reactions, Arginine, Lysine, Degradation, Mediterranean Sea, Mineralization, Radioactive tracers.

The respiratory activity measurement and the study of incorporation processes of the radioactivity in specific organic fractions of the C-14 labeled arginine were among the four day experiments at a simulated water-sediment interface of a mediterranean lagoon environment. During the first day active mineralization occurred, after which the

radioactivity in the acid-soluble fraction decreased and polycondensed products were progressively incorporated. The radioactivity of the H-3 labeled lysine was included mainly in the acid soluble fraction. The radioactivity distribution in the organic fractions was affected by the nature of the substrate, and the reducing conditions in the environment. The identification of amino acids in the acid-soluble and base soluble fractions shows that the labelled arginine and lysine released from the initial compounds are important quantitatively. (Baker-IVI)
W84-05014

GAS EXCHANGE RATES ACROSS THE SEDIMENT-WATER AND AIR-WATER INTERFACES IN SOUTH SAN FRANCISCO BAY,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
B. Hartman, and D. E. Hammond.
Journal of Geophysical Research, Vol. 89, No. C3, p 3593-3603, May, 1984. 7 Fig, 5 Tab, 40 Ref. NSF grants OCE 7909412 and OCE 8209249, OSG grant NA81AA-D00094.

Descriptors: *Gas exchange, *San Francisco Bay, *California, *Water-sediment interfaces, *Air-water interfaces, Radon radioisotopes, Channels, Shoals, Wind.

Radon 222 concentrations in the water and sedimentary columns and radon exchange rate across the sediment-water and air-water interfaces have been measured in a section of south San Francisco Bay. Two independent methods have been used to determine sediment-water exchange rates, and the annual averages of these methods agree within the uncertainty of the determinations, about 20%. The annual average of benthic fluxes from shoal areas is nearly a factor 2 greater than fluxes from the channel areas. Fluxes from the shoal and channel areas exceed those expected from simple molecular diffusion by factors of 4 and 2, respectively, apparently due to macrofaunal irrigation. Values of the gas transfer coefficient for radon exchange across the air-water interface were determined by constructing a radon mass balance for the water column and by direct measurement using floating chambers. The chamber method appears to yield results which are too high. Transfer coefficients computed using the mass balance method range from 0.4 m/day to 1.8 m/day, with a 6-year average of 1.0 m/day. Gas exchange is linearly dependent upon wind speed over a wind speed range of 3.2-6.4 m/s, but shows no dependence upon current velocity. Gas transfer coefficients predicted from an empirical relationship between gas exchange rates and wind speed observed in lakes and the oceans are within 30% of the coefficients determined from the radon mass balance and are considerably more accurate than coefficients predicted from theoretical gas exchange models. (Author's abstract)
W84-05111

GROUPS OF WAVES IN SHALLOW WATER,
Scripps Institution of Oceanography, La Jolla, CA.
S. Elgar, R. T. Guza, and R. J. Seymour.
Journal of Geophysical Research, Vol. 89, No. C3, p 3623-3634, May, 1984. 10 Fig, 1 Tab, 28 Ref. OSG contracts NOAA-04-8-M01-193 and R-CZ-N-4E, ONR contract N00014-75-C-0300.

Descriptors: *Waves, *Mathematical models, Simulation, Wave height, Water depth.

Wave group statistics predicted by linear theories are compared to numerical simulations, thus determining ranges of spectral shapes for which the theories are valid. It is found that these theories are not generally valid for ocean data because of many assumptions and simplifications beyond linearity and random phase or because their range of applicability does not include the vast majority of ocean conditions. The simulations also provide quantitative information about the variability of linear wave group statistics which is useful when examining ocean field data. The simulation technique is used to show that important ocean gravity wave group statistics are not inconsistent with an underlying wave field composed of linearly superposed random waves. The majority of the field data examined were collected in 10 m depth: significant wave heights varied from about 20 to 200 cm, and the spectral shapes ranged from fairly narrow to broad ($1 < Qp < 6$). For the 10-m depth data, the observed mean run length, variance of run length, and probabilities of runs of a given number of waves were statistically consistent with the simulations. In contrast to the apparently linear groups observed in 10 m depth, waves in 2-3 m depth showed marked departures from the linear simulations. (Author's abstract)
W84-05112

NUTRIENT TRAPPING BY SEDIMENT DEPOSITION IN A SEASONALLY FLOODED LAKESIDE WETLAND,
Wisconsin Univ.-Madison. Dept. of Soil Science.
C. A. Johnston, G. D. Bubenzer, G. B. Lee, F. W. Madison, and J. R. McHenry.
Journal of Environmental Quality, Vol. 13, No. 2, p 283-290, April-June, 1984. 6 Fig, 3 Tab, 26 Ref. EPA grant R804823.

Descriptors: *Wetlands, *Sediment deposition, *Nutrients, Water quality, Soil chemistry, Nitrates, Phosphates, Flooding, Alluvium, White Clay Lake, Wisconsin.

Sediment and nutrient retention was studied in a seasonally flooded lakeside wetland as a natural mechanism for preventing water quality deterioration. Both wetland and upland soils in the watershed had comparable concentrations of inorganic P on a per-volume basis, while NH4(+)-N and organic forms of N and P were much higher in the wetland soils. Nitrate concentrations expressed in a per-volume basis were lower in the wetland soils than in the upland soils. The distribution of sediment and nutrients in the wetland was correlated with distance from a small stream flowing through the wetland. Deposition patterns were affected by recent stream channel migrations. The accumulation of nutrients and sediment delivered from the upland to wetland soils was estimated in two ways: (i) by calculating the volume of alluvium deposited in low natural levees adjacent to the stream; and (ii) by estimating nutrient and ash enrichment of histic surface soils farther away from the stream. Although the levees constituted only about 20% of the wetland surface area, they accounted for 81% of the sediment, 84% of the N, and 67% of the P retained by the wetland. The depth of Cs-137 in the soil was used to estimate net sedimentation rates. Average annual accumulations over the wetland as a whole were: 2.0 kg sediment/sq m/yr, 2.6 g P/sq m/yr, and 12.8 g N/sq m/yr. Since these values exceed those published for average annual storage by wetland plants, soil mechanisms are more important than vegetative uptake for long-term nutrient and sediment retention in the White Clay Lake wetland. (Author's abstract)
W84-05121

APPLICATION OF COLUMBIA HYBRID MODELING SYSTEM,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. H. McAnally, Jr., J. V. Letter, Jr., J. P. Stewart, W. A. Thomas, and N. J. Brogdon, Jr.
Journal of Hydraulic Engineering, Vol. 11, No. 5, p 627-642, May, 1984. 15 Fig, 4 Tab, 6 Ref.

Descriptors: *Model studies, *Estuaries, *Columbia River, Columbia Hybrid Modeling System, Runoff, Waves, Tidal effects, Shoals, Sedimentation.

The Columbia Hybrid Modeling System was applied to navigation channel shoaling problems at the mouth of the Columbia River estaury. The adjustment process created a typical year from a statistical analysis of river runoff and waves combined with a typical tide. The Columbia hybrid modeling method integrates field data, analytical techniques, a physical model, and numerical models into a solution technique that uses each method to do that which it performs best. The Columbia hybrid modeling method yielded results that are believed to be superior to any other presently available production-level technique. The Columbia River estuary physical model has been verified to satisfactorily reproduce observed prototype water surface evaluations and current velocities. Results of model predictions of changes in hydraulics from model base test results are considered reliable indications of expected prototype behavior. The Columbia entrance hybrid model has been verified to yield accurate reproductions of total dredged volume and longitudinal channel shoaling distribution, and satisfactorily accurate cross channel shoaling patterns. The model overpredicts shoaling on the outer bar. Results of model predictions can be considered reliable indications of the effects of possible modifications to the entrance in terms of changes from the base conditions, so long as those modifications do not severely alter the flow regime. The techniques developed are flexible enough and general enough to permit their application to many similar sedimentation problems in rivers and estuaries. (Baker-IVI)
W84-05149

CHANGES IN DIATOM FLORA DEPOSITED ANNUALLY DURING THE FRESHENING OF THE IMPOUNDED, SEA-BAY OF GENNARBY-VIKEN IN SOUTHERN FINLAND,
Turku Univ. (Finland). Dept. of Quaternary Geology.
M. Rasanen, and K. Tolonen.
Hydrobiologia, Vol. 103, p. 147-152, July, 1983. 5 Fig, 20 Ref.

Descriptors: *Diatoms, *Salinity, *Water resources development, *Finland, *Gennarbyviken Bay, Sulfides, Mud, Sediments, Environmental effects, Bays.

Gennarbyviken is a 17-km long sea-bay on the northern coast of the Gulf of Finland. It was dammed in 1957-58 to form a fresh-water supply. Diatoms were studied in an annually laminated sulfide mud which was deposited after the impoundment of the sea-bay of Gennarbyviken. It was possible to follow how the measured decrease in salinity in the basin was reflected by the diatom flora of the sediment which had been deposited concurrently. At the beginning of the freshening period (6-8 years), decreasing salinity was the most important factor which caused changes in the diatom communities. Diatoms reacted immediately to the decreasing salinity. Afterwards oligohalobes became the dominant species group. Results were compared with another study and it was determined that when changes are monitored through time, more precise information about the salinity ecology for diatoms can be acquired than when differences in space are studied where the sources of error are bigger. (Baker-IVI)
W84-05220

DENITRIFICATION IN SAN FRANCISCO BAY INTERTIDAL SEDIMENTS,
Geological Survey, Menlo Park, CA.
R. S. Oremland, C. Umberger, C. W. Culbertson, and R. L. Smith.
Applied and Environmental Microbiology, Vol. 47, No. 5, p 1106-1112, May, 1984. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Denitrification, *San Francisco Bay, *Intertidal sediments, Estuaries, Nitrates, Nitrogen removal, Chemical properties, Sediment slurries, Ions.

Denitrification can benefit aquatic environments faced with eutrophication. The Sediments were taken from an intertidal mudflat located in South San Francisco Bay. Acetylene block technique was employed to study denitrification in intertidal estuarine sediments. Addition of nitrate to sediment slurries stimulated denitrification. During the dry season, sediment-slurry denitrification rates displayed Michaelis-Menten kinetics, and ambient NO3(-) + NO2(-) concentrations ($<$ or $=$ 26 micro M) were below the apparent Km (50 micro M) for nitrate. During the rainy season, when ambient NO3(-) + NO2(-) concentrations were higher (37 to 89 micro M), an accurate estimate of the Km could not be obtained. Endogenous deni-

trification activity was confined to the upper 3 cu cm of the sediment column. However, the addition of nitrate to deeper sediments demonstrated immediate N2O production, and potential activity existed at all depths sampled (the deepest was 15 cm). Loss of N2O in the presence of C2H2 was sometimes observed during these short-term sediment incubations. Experiments with sediment slurries and washed cell suspensions of a marine pseudomonad confirmed that this N2O loss was caused by incomplete blockage of N2O reductase by C2H2 at low nitrate concentrations. Areal estimates of denitrification (in the absence of added nitrate) ranged from 0.8 to 1.2 micro mol of N2/sq m/h (for undisturbed sediments) to 17 to 280 micro mol of N2/sq m/h (for shaken sediment slurries). (Murphy-IVI)
W84-05281

DISTRIBUTION AND GEOCHEMISTRY OF SOME TRACE METALS IN THE BERMUDA COASTAL ENVIRONMENT,
Bermuda Biological Station for Research, St. George's West.
T. D. Jickells, and A. H. Knap.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 3, p 245-262, March, 1984. 7 Fig, 7 Tab, 37 Ref.

Descriptors: *Geochemistry, *Trace metals, *Bermuda, *Coastal waters, Metals, Chemical analysis, Sediments, Path of pollutants.

Results of the analyses of the water column and sediments of the Bermuda Platform for Cd, Cu, Fe, Mn, Ni, Pb and Zn are presented. The major process controlling the water column concentrations is physical mixing of open ocean waters with inshore waters, which are polluted by a wide range of diffuse inputs. Sedimentation within the inshore waters plays a lesser, but significant, role as do fluxes from the sediments of Fe and Mn and possibly phytoplankton uptake of Zn. Concentrations within the sediments are controlled by the formation of trace metal enriched clay/organic particles in the inshore areas and their subsequent redistribution by sediment resuspension, except for Fe and Mn which are largely associated with clay lattices. (Author's abstract)
W84-05287

SHELL OF MYTILUS AS AN INDICATOR OF ZONAL VARIATIONS OF WATER QUALITY WITHIN AN ESTUARY,
Dundee Univ. (Scotland). Dept. of Geology.
For primary bibliographic entry see Field 5B.
W84-05288

STRATIGRAPHIC EVIDENCE OF EUTROPHICATION IN AN ESTUARY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
G. C. Brush.
Water Resources Research, Vol. 20, No. 5, p 531-541, May, 1984. 5 Fig, 5 Tab, 41 Ref.

Descriptors: *Eutrophication, *Estuarine environment, *Stratigraphy, Algal growth, Chlorophyll, Sediments, Watershed, Fertilizers, Black River, Chesapeake Bay, Bays.

Using vertical profiles of sedimentary chlorophyll degradation products extracted from sediment cores, a comparison was made of algal productivity in Black River, an estuary of Chesapeake Bay, during the time prior to urbanization when the watershed was cultivated extensively for agriculture with productivity during the period of urbanization when secondarily treated effluent was discharged into the river from a sewage treatment plant. The productivity of the Black River was then compared to that of an adjacent estuary, Middle River, during the same time period. Vertical changes in chlorophyll degradation products showed a significant increase in algal productivity with the introduction of sewage effluent into the river. By comparison, algal production during intensive agriculture of the watershed, including heavy applications of fertilizers, was less by an order of magnitude where there was no sewage discharge from a point source. Concentrations of orthophosphorus correspond with concentrations of algal cells and chlorophyll in the water column and are greater by an order of magnitude where sewage is discharged into an estuary draining an urban-agricultural watershed than where there is no sewage. The response of the estuary to short- and long-term changes in the amount of sewage discharged is reflected by similar changes in chlorophyll production. However, chlorophyll production does not correspond with increases in the amount of fertilizers used in recent years over the amount used in the middle to late nineteenth century. (Baker-IVI)
W84-05327

SURFACE INFILTRATION IN SALT MARSHES: THEORY, MEASUREMENT, AND BIOGEOCHEMICAL IMPLICATIONS,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 2G.
W84-05332

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVERSE OSMOSIS MEMBRANES BASED ON CYCLOALIPHATIC IMIDE POLYMERS,
Rohm and Haas Co., Springhouse, PA. Research Div. Labs.
P. G. Cartier, and P. Osei-Gyimah.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 171107, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, (1984). 64 p, 8 Fig, 24 Tab, 10 Ref, 1 Append. Project No. OWRT C-00148-S(9406)(1), Contract/Grant No. 14-34-0001-9406.

Descriptors: *Reverse osmosis, *Membrane processes, *Desalination, Polymers, *Polymer synthesis, *Cycloaliphatic imide polymers, Direct osmosis, Dense membranes.

Cycloaliphatic polyglutarimides are promising new membrane polymers. Water and salt permeabilities of the new imide polymers as measured by direct osmosis and the chemical stability of these membranes show that several of the novel imides are intrinsically suited for fabrication into reverse osmosis membranes. Water/salt permeability ratios determined by direct osmosis range from 400 to 2400. Similar ratios are reported for dense membranes prepared from cellulose acetate. Membrane performance is not degraded by a 124 hour soak in 250 ppm Cl2 at pH = 10.5. However, we have been unsuccessful in attempts to fabricate these polymers into membranes with NaCl rejection greater than 90%. Dense, asymmetric and thin film composite membranes were prepared. Nine new polymers were synthesized from the polymeric ammonia imide (R=H) by the substitution of a series of R-groups for the H of the ammonia imide. The R-groups were chosen to promote moisture uptake in the resulting polymer. The ammonia imide base polymer was selected for its good thermal and mechanical properties and its chemical stability. Dense membranes of the ammonia imide(R=H) increased salt rejection. However, NMR analysis shows that the increase in rejection is due to glutarimide ring opening. Ring opening is undesirable as it lowers the mechanical and chemical stability of the polymer.
W84-04883

TECHNOLOGICAL AND ENVIRONMENTAL ASPECTS OF DESALINATION,
Silver (R.S.), Oakbank (Scotland).
R. S. Silver.
Desalination, Vol. 42, No. 1, p 1-9, July, 1982.

Descriptors: *Desalination, *Reviews, Technology, Environmental effects, History, Thermodynamics.

Industrial and sociological importance of desalination are reviewed. The history of its development particularly in the last two decades is described and the task of foreseeing the developments to come in the next twenty years is attempted. Fundamental analysis of desalination processes is offered in terms of thermodynamics, demonstrating the interaction between practical necessities and thermodynamic imperatives. It is shown how the implications of the analysis have in fact been confirmed by the history of development, and so suggests confidence in the interpretation for the future. (Baker-IVI)
W84-04926

PURAQ SEAWATER DESALINATION PROCESS,
Puraq Co., New Haven, CT.
L. Lazare.
Desalination, Vol. 42, No. 1, p 11-16, July, 1982. 3 Fig.

Descriptors: *Desalination, *Seawater, Process control, Temperature effects, Salinity, Heat recovery, Corrosion control.

The Puraq seawater desalination process is based on the liquid-liquid extraction of product water using a polymeric solvent, custom-synthesized to satisfy a particular set of design conditions, namely maximum seawater temperature and salinity. The solvent is a copolymer of various epoxide monomers, has a molecular weight in the range of 1800 to 3000, specific gravity of 1.10-1.15 and a viscosity under operating conditions between 10 and 40 cp. The phase diagram has a lower consulate temperature and the phase relationships roughly follow the Flory-Huggins equations for polymer solutions. The scheme is extremely simple and the equipment consists of liquid-liquid heat exchangers of the shell-and-tube type for heat recovery from the blowdown brine and product water streams, a deaerator for corrosion control and for protection of the solvent against oxygen-induced degradation, and centrifugal contactors of specially adapted design. (Baker-IVI)
W84-04927

CHANGING FACE OF DESALINATION - A CONSULTING ENGINEER'S VIEWPOINT,
Binnie and Partners, London (England).
F. C. Wood.
Desalination, Vol. 42, No. 1, p 17-25, 1982. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Desalination, *Viewpoint, Desalination, Seawater, Water quality, Marketing, Desalination apparatus, Review, Economic aspects, Performance evaluation.

The present major market for desalting plants will continue to rely mainly upon the proven MSF process until local policy dictates a need for resources conservation or the long-term merits of RO, as well as its high energy-efficiency, are well established. On the other hand, industrialized, oil-importing countries, with increasing water shortages and environmental constraints, must develop energy-efficient processes for single- and dual-purpose operation as well as improve RO membranes for desalting of seawater. The needs of small-plant users require particular consideration if the simple yet reliable plants which their circumstances demand are to be satisfied. Solar plants are likely to find their initial commercial applications in this market. (Author's abstract)
W84-04928

VERTICAL TUBE FOAM EVAPORATION FOR WATER DESALINATION,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton.
Desalination, Vol. 42, No. 1, p 27-35, July, 1982. 4 Fig, 14 Ref.

Descriptors: *Vertical tube foam evaporation, *Desalination, *Desalination apparatus, Perform-

ance evaluation, Vapor compression distillation, Economic aspects, Desalination wastes.

Vertical tube foam evaporation (VTFE) provides a method of enhancing evaporator performance substantially by increasing the brine-side heat transfer coefficient. It reduces the temperature needed to drive evaporation and the energy required; consequently, the evaporation rate or evaporator capacity is increased under constant temperature conditions. VTFE applied to multiple effect evaporators, to evaporation with vapor compression to drive the process and to waste-heat evaporation of aqueous solutions are illustrated by test data obtained with pilot plants operated under realistic process conditions and utilizing full-size distillation tubes. Retrofitting of some industrial VTE installations to permit VTFE modes of operation and additional VTFE effects within the same available temperature span would improve both the production capacity and performance ratio of such plants, utilizing the same steam source and coolant supply. The vapor compression VTFE method provides a flexible and energy-saving technique for augmenting pre-existing industrial VTE facilities by operating the VC-VTFE as a topping effect instead of or in conjunction with boiler steam. This enhances both evaporator capacity and energy efficiency. The VC-VTFE also provides energy reductions for evaporation crystallization, waste-water renovation-recycle, and desalination. Wast-heat VTFE can be integrated with many existing thermal power plants or in future designs to augment turbine efficiency, produce distilled water for boiler feed and potable or in-plant use, and for accomplishing zero discharge needs. The very low energy requirements of WH-VTFE, for pumping only, apparently reduces the cost of distilled water produced by this technology to the lowest obtainable industrially. (Murphy-IVI)
W84-04929

COURTAULDS DESALINATION PROCESS,
Courtaulds Ltd., Coventry (England).
D. C. F. Pratt.
Desalination, Vol. 42, No.1, p 37-45, July, 1982. 1 Fig.

Descriptors: *Desalination, *Heat transfer, Plastics, Distiller units, Mechanical equipment, Vapor compression distillation, Distillation.

A practical form of plastic heat transfer surface was developed for vapor recompression desalination. The process was aimed at using a cheap, polymeric heat transfer surface; using a large heat transfer surface in order to reduce the temperature differential for heat transfer, and using a particularly low compression ratio that could be provided by a fan rather than a compressor and would result in low energy consumption. The use of this surface to give very low energy vapor recompression desalination is outlined. The layout of a full-scale distiller unit is described and expected energy consumption figures are given. For full-scale plants the aim in energy consumption is around 1 MW of electricity for 1 mIgd of product. The predicted figure for a 7 mgd plant is 7.2 MW, excluding lighting. If it is assumed that a power station generates electricity at 3% efficiency and that evaporation of water requires 0.293 kWh/lb, this gives a performance coefficient of just under 40. If half the fans are driven by steam turbines taking 50 psig steam from a nearby power station, with some superheat, and the remaining energy is supplied by diesels, the performance coefficient becomes about 26 but the capital cost will benefit. (Baker-IVI)
W84-04930

DESALINATION OF BRACKISH WATER BY ELECTRODIALYSIS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
W. P. Harkare, S. K. Adhikary, P. K. Narayanan, V. B. Bhayani, and N.J. Dave.
Desalination, Vol. 42, No. 1, p 97-105, July, 1982. 2 Fig, 5 Tab, 5 Ref.

Descriptors: *Desalination, *Electrodialysis, *Brackish water, Potable water, Membrane processes, Water supply development, Rural areas, Developing countries, Energy.

For rural areas in India, electrodialysis, being a low energy consuming technique, has an advantage over other membrane processes. The performance of an electrodialysis unit comprising interpolymer type cation and anion-exchange membrane for desalting of brackish water having different total dissolved solids up to 4000 ppm has been studied. Emphasis is placed on the energy requirements and pressure drop under different conditions. The power requirement is of a low order, with high current efficiencies at optimum operational conditions. The total pressure drop across the stack is also very low and is in the range of 1 to 2 psi. Brackish water having total dissolved solids from 1800 to about 4000 ppm can be desalted to yield potable water, with a very low energy requirement ranging from 0.5 to 2.1 kWh/cubic m. The findings are useful for the design and operation of desalination plants. (Baker-IVI)
W84-04931

PERFORMANCE OF THE 12,000 M3/D SEAWATER REVERSE OSMOSIS DESALINATION PLANT AT JEDDAH, SAUDI ARABIA, JANUARY 1979 THROUGH JANUARY 1981,
UOP, Inc., San Diego, CA. Fluid Systems Div.
A. Muirhead, S. Beardsley, and J. Aboudiwan.
Desalination, Vol. 42, No. 2, p 115-128, August, 1982. 3 Fig, 6 Tab.

Descriptors: *Desalination, *Reverse osmosis, *Saudi Arabia, *Jeddah, Mechanical equipment, Failure, Safety, Corrosion, Membrane processes, Membranes, Resins, Seawater.

The 12,000 cu m/day seawater reverse osmosis (RO) plant built for the Saudi Arabian government and installed at Jeddah has been on-line since completion of the acceptance test in January of 1979. The system was designed to produce 12,000 cu m/day with a permeate total dissolved solids of 1000 mg/l or less. The system was designed using diesel engines as prime movers, which has had a major impact on the maintenance costs incurred during the two year operation period. Numerous problems have occurred at the system resulting from the environment, equipment not performing as expected, and substandard materials. These factors have led to premature failures, unanticipated maintenance costs and the need to replace membrane elements. Corrosion of all metal piping used to carry seawater and brine has occurred. Two of the three original Kato generators open circuited after six months of operation. Algae formed in the sea intake and the sand filter splitter box. Failure was also noted in the high pressure hose, vessel studs, the RO vessel support structure, and the membrane element. (Baker-IVI)
W84-04932

DESALINATION BY ED AND EDR - STATE-OF-THE-ART IN 1981,
Ionics, Inc., Watertown, MA.
W. E. Katz.
Desalination, Vol. 42, No. 2, p 129-139, August, 1982. 4 Fig, 10 Ref.

Descriptors: *Desalination, *Electrodialysis, *Electrodialysis reversal, Membrane processes, Brackish water, Salinity, Energy.

Recent developments in electrodialysis (ED) and electrodialysis reversal (EDR) processes have led to more extensive use of these methods for desalination. Information is provided on how EDR has achieved a major increase in the stability of membrane process performance. The growth in usage of EDR and EDR installations for brackish water desalting is reviewed in relation to the growth of desalination in general. Key new developments in ED and EDR over the past few years are reviewed. The wide spectrum of natural and man-made water salinities are noted and areas of this spectrum where ED and EDR are currently applicable are cited. In addressing the future market EDR has a number of attractions: a low energy consumption (3- to 5 kWh/1000 gal, including pumping), long term process stability with minimal pretreatment, and proven 5 to 10 year membrane life. (Baker-IVI)
W84-04933

DESALINATION BY THE IMPROVED VACUUM FREEZING HIGH PRESSURE ICE MELTING PROCESS,
New Mexico Univ., Albuquerque. Dept. of Chemical and Nuclear Engineering.
C. Y. Cheng, Y. F. Su, and D. N. Hopkins.
Desalination, Vol. 42, No. 2, p 141-151, August, 1982. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Desalination, *Vacuum freezing high ice melting process, Desalination apparatus, Desublimation, Freezing, Surface freezer, Ice pressure, Ice-brine systems.

The basic vacuum freezing high pressure ice-melting process VFPIM was studied. The VFPIM process does not require a compressor nor an absorbing solution for low pressure water vapor, nor a refrigeration loop (heat pump) to reuse the heat released in the condensation or desublimation of the low pressure water vapor in supplying the latent heat of melting ice. The process uses commercially available components and can thus be operated reliably. An extended surface freezer was found to have several advantages over the conventional spray freezer. The work input needed in the high-pressure ice-melting operation in the VFPIM process is estimated to be about 8.13 kWH. Since the work input to the compressor in the vacuum freezing vapor compression process is reported to be 15.5 kWh, the saving in work input is 7.37 kWh. Since any saving in work input also saves the work input to the refrigeration system, the total saving in the work inputs are 8.40 kWh/1000 gal. Referring to a table of elements of sections of standard aluminum pipes and their bursting pressures, it is seen that 1/4 inch, schedule 80, aluminum pipes made of 6061-T6 alloy have a bursting pressure of 22,450 psi and can be used as melter comduits. Assuming that aluminum pipe costs $1.50 per lb, the cost of the aluminum pipe for a one mgd plant is around $200,000. If an extended surface freezer is used instead of an agitated jet freezer, it is possible to save about 2 kWh/1000 gal. A multistage operation can be easily adopted in the VFPIM Process. In a multistage operation, one may still have only one counterwasher, and simply divide the freezing and melting operations into multistage operations. A significant energy saving can be accomplished by a multistage operation. Work input for the VFPIM Process to produce 1000 gal fresh water is estimated to be 30-35 kWh. (Murphy-IVI)
W84-04934

OPERATIONAL DATA ANALYSIS OF MSF DESALINATION PLANTS. A CASE STUDY OF JEDDAH I,
King Abdulaziz Univ., Jeddah (Saudi Arabia).
I. I. Kutbi, Z. A. Sabri, and A. A. Husseiny.
Desalination, Vol. 42, No. 2, p 163-197, August, 1982. 1 Fig, 29 Tab, 9 Ref.

Descriptors: *Desalination plant, *Desalination, *Operational data analysis, *Multi-stage flash desalination plant, *Jeddah I, Multi-stage flash evaporator, Operating costs, Operating policies, Performance evaluation, Desalination plants.

Monthly operation and maintenance reports of the oldest large MSF plant in Saudi Arabia, Jeddah I, are analyzed to extract information or generic operation and design problems and to seek means for the mitigation of such problems. The plant is a dual purpose plant rated at 50 MW electric power and a 1,893 cu m/d (5 mgd) water production. The accumulated records are quantified to provide estimates of equipment failure rates. Three systems are found to be the major contributors to plant outage namely, make-up water, brine recycle and sea water intake systems. Root causes of the plant unscheduled shutdowns or reductions in water production are assessed to examine generic reasons for deviations of MSF systems from standard expected performance. (Murphy-IVI)
W84-04935

ELECTROCHEMICAL STUDIES ON SEA WATER APPLIED TO DESALINATION,

Group 3A—Saline Water Conversion

Bhabba Atomic Research Centre, Bombay (India). Desalination Div.
M. K. V. Nair, B. M. Misra, and D. G. Vartak.
Desalination, Vol. 42, No. 2, p 199-207, August, 1982. 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Desalination, *Seawater, *Electrochemistry, *Desalination apparatus, Spectral analysis, Hydrogen ion concentration, Calcium, Chlorine, Salinity, Alkalinity, Water properties, Chemical properties.

A study of the overall electrochemical changes taking place during the passage of current in sea water, was undertaken, with a view to utilize this for possible development of a suitable electrochemical pretreatment technique for sea water. Emphasis has been laid on the calcium removal and not for the total weight scale generated. It was also desired to obtain the optimal conditions for chlorine and acid liberation. A current of 0.10 mA/sq m appears optimum for a reasonable Ca/Mg ratio as well as the amount of calcium removal. The role of different cathode materials as well as electrode geometry has been investigated. X-ray and IR spectra of different types of scales generated are presented. (Murphy-IVI)
W84-04936

CALCULATION OF THE EXPECTED PERFORMANCE OF REVERSE OSMOSIS PLANTS,
Envirogenics Systems Co., El Monte, CA.
C. W. Saltonstall, Jr., and R. W. Lawrence.
Desalination, Vol. 42, No. 3, p 247-253, September, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Reverse osmosis, *Desalination, Design criteria, Brine, Membrane processes, Membranes, Mathematical equations, Forecasting, Prediction.

The designer of a reverse osmosis plant must forecast the brine and product stream concentrations from the membrane salt rejection and the ratio of product to feed flows (product recovery). The derivation of equations which predict these concentrations is reviewed and an average feed stream concentration between feed and brine which allows the forecasting of plant productivity at high recoveries is defined. The derived equations are contrasted with other less accurate equations which have been used in the industry. Using the equations provided, the designer can predict the concentrations of the product and brine streams leaving a RO plant from a feed composition and the measured performance of the membrane elements to be used. The designer can determine the membrane rejection required to meet a product concentration specification within specified or desirable constraints of pressure and recovery. The predicted brine concentration is of equal importance, for it allows a judgement as to whether sparingly soluble salts are liable to precipitate from solution near the brine end of the plant. (Baker-IVI)
W84-04937

RELIABILITY ANALYSIS OF REVERSE OSMOSIS PLANT,
King Abdulaziz Univ., Jeddah (Saudi Arabia).
I. I. Kutbi, Z. A. Sabri, and A. A. Husseiny.
Desalination, Vol. 42, No. 3, p 291-313, September, 1982. 18 Fig, 6 Tab, 7 Ref.

Descriptors: *Reverse osmosis, *Management planning, *Desalination, Decision making, Critical path analysis, Fault tree analysis, Seawater, Jeddah, Saudi Arabia.

The applications of the fault tree analysis techniques to reverse osmosis sea water desalination systems are illustrated. Critical failure problem areas are identified and methods of improving the performance of the RO desalination plants are recommended. Failure data has been extracted from operation and maintenance reports of the operating RO desalination plants in Jeddah, Saudi Arabia. An assessment is also made of the impact of failures and outages on the availability of the plant. The seawater intake system was found to need some improvements, such as following a strict preventive maintenance program and selection of proper materials for pumps. Poor operating conditions have been the source of trouble in the plant and the complexity of the system contributed to plant outage. To mitigate some of these problems, operators must keep adequate records, and exercise extreme care in monitoring and controlling the chemistry of the process streams. The design should accommodate human factors engineering aspects. (Baker-IVI)
W84-04938

WATER IN POLYMER MEMBRANES. PART I, WATER SORPTION AND REFRACTIVE INDEX OF CELLULOSE ACETATE,
Agricultural Research Service, Albany, CA. Western Regional Research Center
J. R. Scherer, and G. F. Bailey.
Journal of Membrane Science, Vol. 13, No. 1, p 29-41, January, 1983. 10 Fig, 32 Ref.

Descriptors: *Membrane processes, *Cellulose acetate, Polymers, Membranes, Absorption, Sorption, Films, Humidity, Desalination, Wastewater treatment.

A new technique of integrated optics is applied which allows investigation of the swelling and water absorption properties of dense symmetric films of 0.25 to 4 micrometers in thickness. The dependence of water absorption of membranes of cellulose acetate on relative humidity was determined by measuring small changes in their asymmetric waveguide properties in the visible spectral region. Simultaneous measurements of changes in film thickness provide a direct method for obtaining the change in film volume as a function of water concentration and a new measure of polymer porosity. Data are presented for a typical film fabricated from celluose acetate which illustrate the usefulness of studying water absorption by integrated optics techniques. One conclusion inferred from an interpore spacing of 50 to 60 Angstrom units is that it should be hypothetically possible to increase the number of pores in cellulose acetate membranes without increasing pore diameter and still maintain sufficient polymer interactions for stability under conditions of higher water content. (Baker-IVI)
W84-05048

3B. Water Yield Improvement

MUNICIPAL WASTEWATER REUSE FOR VARIOUS APPLICATIONS,
Katholieke Univ. Leuven (Belgium). Industrial Chemistry Section.
A. Van Haute.
Public Health Reviews, Vol. 11, No. 2, p 135-176, April-June, 1983. 4 Fig, 6 Tab, 21 Ref.

Descriptors: *Water reuse, *Reviews, Water supply development, Salinity, Calcium, Nutrients, Public health, Municipal wastewater, Wastewater irrigation, Groundwater recharge, Recreation, Potable water.

Various types of water consumption needs can be met through the use of treated wastewater. Water reuse is a planned, well-reviewed option for agriculture, recreational impoundment, industry, groundwater recharge and municipalities. Some case histories in each field of water reuse are given. In addition to increasing the supply of water available through water reuse programs, a number of other potential benefits result. These include reduced discharges of pollutants to environmentally fragile surface waters and the availability of nutrients when used for crop irrigation. The very wide spectrum of potential applications for reused water is reflected in a need for research in many diverse areas. The most critical area for reuse is potable supplies, and here the identification of potential health effects is paramount. There are also hazardous chemicals to be considered in irrigation water including soluble salts, sodium, boron or other toxic elements, and, under some conditions, bicarbonate concentrations in relation to the concentration of calcium plus magnesium. Requirements for wastewater treatment prior to application to the land by slow rate systems are variable, depending on the local regulatory agency requirements. (Baker-IVI)
W84-04804

INFLUENCE OF TILLAGE SYSTEMS ON SOIL PHYSICAL PARAMETERS AND INFILTRATION AFTER PLANTING,
Agricultural Research Service, Morris, MN. North Central Soil Conservation Research Center.
M. J. Lindstrom, and C. A. Onstad.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 149-152, March-April, 1984. 5 Tab, 14 Ref.

Descriptors: *Corn, *Tillage, *Infiltration, *Soil physical properties, Crop residues, Soil density, Permeability coefficient, Pore size, Surface runoff, Soil erosion, No-till.

Simulated rainfall trials were conducted immediately after planting during the third crop year in a continuous-corn rotation of an established tillage experiment designed to evaluate the effects of residue harvest on soil physical properties. Tillage systems were (a) fall moldboard plow, spring disk; (b) fall chisel plow, spring disk; and (c) modified no-till. Each tillage plot was split, and corn stover was harvested each year from the same half of the plots. Commerical harvesting equipment was used to remove about 70% of the above-ground plant material. Soil physical parameters measured at the time of simulated rainfall were (a) random roughness, (b) bulk density, (c) saturated hydraulic conductivity, (d) penetrometer resistance, and (e) pore size distribution. Residue harvest in the first two crop years had no measurable effect on the soil physical properties. The plots differed in bulk density, penetrometer resistance, saturated hydraulic conductivity, and pore size distribution in the Ap horizon, but not in the lower horizons. Artificial rainfall was applied at 5.6 cm/hr (2.2 in.) under relatively low energy (55% of natural rainfall energy) for 1 hr and then again for 45 min about 24 hr later. Water runoff and soil erosion differences were observed among the tillage treatments. The no-till system produced the greatest runoff regardless of residue harvesting. Soil erosion was greatest with the no-till system when residue had been harvested. The soil physical parameters measured indicated that the no-till system forms as undesirable surface condition characterized by high bulk density, high penetrometer resistance, low saturated hydraulic conductivity, and low volume of macropores, all of which can promote rapid water runoff under normal rainfall conditions. (Author's abstract)
W84-05058

PRELIMINARY QUANTIFICATION OF THE IMPACTS OF ASPEN TO CONIFER SUCCESSION ON WATER YIELD - II. MODELING RESULTS,
Utah State Univ., Logan. Coll. of Natural Resources.
For primary bibliographic entry see Field 2A.
W84-05156

3C. Use Of Water Of Impaired Quality

PUBLIC HEALTH ASPECTS OF WATER REUSE,
LunDean Environmental Co., Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W84-04805

MANAGING WATER QUALITY BY MIXING WATER FROM DIFFERENT SOURCES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
T. Liang, and S. Nnaji.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 48-57, January, 1983. 6 Fig, 5 Tab, 4 Ref.

Descriptors: *Water quality control, Mixing, Water supply development, Irrigation, Sugarcane, Water quality, Well water, Wells, Pumping, Economic aspects.

Mixing of water of different quality sometimes can produce water of usable quality without resorting to expensive water purifying processes. A procedure for determining the optimal manner to mix the water from a finite number of sources for quality improvement is presented. The procedure can also be used to determine the optimal strategy for purifying some of the water so that usable water can be obtained. The example calls for mixing water from three wells of varying quality such that it can be used for irrigation of sugarcane which has a moderate salt tolerance. The problem is to determine how much water should be pumped daily from each well such that the mixed water will not only satisfy irrigation needs in quantity and quality, but also can be obtained within the daily pumping time limit and at the lowest cost. Piping material and energy needed to deliver water account for most of the cost. The model developed can also be applied to a dynamic situation when the quality of the water source varies from time to time (such as treated water from a sewage plant). The model probably can be used first to determine the maximum size of the capacity of each water source such as pipe and pump. Receiving water quality information periodically from water monitors, the model can then be used to determine the amount of water to be pumped from each well such that quality standards can be met at minimal operating costs. (Baker-IVI)
W84-04955

USE OF SALINE WATER FOR SUPPLEMENTAL IRRIGATION OF SUGARCANE,
Agricultural Research Service, Hyattsville, MD.
J. R. Thomas, F. G. Salinas, and G. F. Oerther.
Agronomy Journal, Vol. 73, No. 6, p 1011-1017, November-December, 1981. 5 Fig, 7 Tab, 24 Ref.

Descriptors: *Supplemental irrigation, *Sugarcane, *Saline water, *Impaired water quality, *Texas, Groundwater, Chloride, Crop yield, Water quality, Salinity, Salinification, Plant growth.

Supplemental irrigation of sugarcane with saline ground waters may become necessary in the Lower Rio Grande Valley of Texas, since the water requirement of this crop greatly exceeds the irrigation water allotment. Experimental objectives were to determine the feasibility of using saline ground water for supplemental irrigation of sugarcane and to compare the effects of water quality on cane and sugar yields, juice quality, and the mineral composition of leaves and juice. Sugarcane cv. 'N.Co. 310' growing on Hidalgo sandy clay loam (Typic Calciustolls) was irrigated with river (EC = 1.4 mmho/cm) and a prepared saline water (EC = 4 mmho/cm) under five irrigation treatments. Yields of cane (r = -0.85, significant at the 0.05 level of probability), seasonal mean stalk elongation rate (r = -0.95, significant at the 0.01 level of probability), stalk length at harvest (r = -0.94, significant at the 0.01 level of probability) and electrical conductivity (ECj) of the juice (r = -0.93) were linearly correlated with the weighed mean salinity (ECw) of the irrigation waters in 1974, a relatively dry year. Juice Cl concentrations were linearly correlated (r = 0.94, significant at the 0.01 level of probability) with the Cl concentrations of the irrigation waters. Because of the leaching effect of rainfall, the effects of saline water irrigations on soil salinification and plant growth were minimized. Root zone salinity (ECe) levels were less than the threshold salinity level of 5.9 mmho/cm. Consequently, the effects of water quality on yields were small and generally nonsignificant. The average annual rainfall (67.9 to 43.9 cm) across the Lower Rio Grande Valley is probably sufficient to lower salinity if saline well waters were used for supplemental irrigation on medium texture soils. In 1974, 42.3 cm of rain after the final irrigation decreased the ECsw values at the 46 cm depth to less than 1 mmho/cm. This suggests that waters with salinity concentrations above 4 mmho/cm could probably be used to irrigate sugarcane of medium texture soils in the Lower Rio Grande Valley of Texas. (Author's abstract)
W84-04973

CORN RESPONSE TO IRRIGATION ON SURFACE-MINED LAND IN WESTERN ILLINOIS,
Illinois Univ. at Urbana-Champaign.
R. E. Dunker, I. J. Jansen, and M. D. Thorne.
Agronomy Journal, Vol. 74, No. 3, p 411-414, May-June, 1982. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Land reclamation, *Strip mine wastes, *Irrigation water, *Corn, *Illinois, Water stress, Strip mine lakes, Crop yield, Wheel spoil, Mine soils.

Moisture stress is one of the major yield limiting factors for row crops grown in the field on newly constructed mine soils. Response of corn (Zea mays L.) to irrigation on recently constructed mine soils in west-central Illinois was studied over a two-year period to determine the feasibility of utilizing water from surface-mine lakes for irrigation of row-crops on reclaimed land. Two constructed soils, one with 45 cm of topsoil replaced on wheel spoil and one consisting of wheel spoil only, were studied. Both soils are Typic Udorthents. A lake formed in an abandoned mine incline supplied water to a solid-set overhead revolving impact sprinkler system, randomly placed within each soil treatment which applied 3.8 cm of water each week to the irrigated treatment until physiological maturity. Irrigation significantly increased corn yield in 1979 by 2,260 kg/ha for topsoil over wheel spoil and 2,630 kg/ha for wheel spoil only. The weather pattern in 1980 was distinctly different than in 1979 with severe stress during anthesis in 1980. Corn yield response to irrigation in 1980 ranged from 3,450 kg/ha to 6,030 kg/ha among soil treatments. Topsoil replacement resulted in significant yield increases with irrigation in both years. Without irrigation topsoil replacement resulted in a yield increase in 1979 and a yield reduction in 1980. The data suggest that corn will perform well under favorable moisture conditions on newly constructed soils but is quite sensitive to moisture stress. Yields can be increased by irrigation using good quality water from surface mine lakes to alleviate this moisture stress. (Author's abstract)
W84-04982

UTILIZATION OF RECYCLED IRRIGATION WATER ON MARIGOLDS FERTILIZED WITH OSMOCOTE AND CONSTANT LIQUID FERTILIZATION,
California State Univ., Fresno.
For primary bibliographic entry see Field 3F.
W84-05072

BACTERIOLOGICAL QUALITY OF CROPS IRRIGATED WITH WASTEWATER IN THE XOCHIMILCO PLOTS, MEXICO CITY, MEXICO,
Universidad Nacional Autonoma de Mexico, Mexico City. Dept. de Quimica de la Atmosfera y Estudios del Agua.
I. Rosas, A. Baez, and M. Coutino.
Applied and Environmental Microbiology, Vol. 47, No. 3, p 1074-1079, May, 1984. 3 Fig, 5 Tab, 30 Ref.

Descriptors: *Bacterial analysis, *Crop production, *Wastewater irrigation, *Xochimilco, *Mexico, *Mexico City, *Irrigation effects, Irrigation practices, Coliforms, Vegetables, Environmental effects.

Xochimilco county plots (Mexico City), one of the most fertile agricultural areas in the Valley of Mexico, produce a large portion of the fresh vegetables consumed in the city. These plots are generally irrigated with domestic wastewater, and for this reason, it was deemed important to examine and evaluate the bacteriological quality of the water, soil, and vegetables from these plots that are harvested and marketed. The soils were also examined for the classical parameters such as nitrates, ammonia, etc., and organic matter and texture. The crops selected for this study were radishes, spinach, lettuce, parsley, and celery because they are usually consumed raw. The highest bacterial counts were encountered in leafy vegetables, i.e., spinach (8,700 for total coliform and 2,400 for fecal coliform) and lettuce (37,000 for total coliform and 3,600 for fecal coliform). Statistically significant differences in bacterial counts between rinsed and unrinsed edible portions of the crops were observed. In rinsed vegetables high densities of fecal coliform were detected, indicating that their consumption represents a potential health hazard. The total coliform values found in irrigation water ranged from 40,000 to 290,000, and for fecal coliform the values ranged from 500 to 3,000. (Author's abstract)
W84-05280

3D. Conservation In Domestic and Municipal Use

RESULTS OF THE IMPLEMENTATION OF THE DIRECTIVE ON RATIONAL WATER USE IN THE 1981-1985 FIVE-YEAR PLAN (ERGEBNISSE BEI DER VERWIRKLICHUNG DER DIREKTIVE ZUR RATIONELLEN WASSERVERWENDUNG IM FUNFJAHRPLAN 1981 BIS 1985),
Ministerium fuer Umweltschutz and Wasserwirtschaft, Berlin (German D.R.).
G. Voigt.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 147-148, May, 1983.

Descriptors: *East Germany, *Water conservation, *Water use, Water supply, Water demand, Industrial water, Domestic water, Municipal water, Water pollution control.

The Tenth Party Conference (TPC) of the German Democratic Republic charged water management with providing an adequate and stable water supply in the long term, the key to which is ever-increasing rational water use (RWU). Measures instituted so far as a result of TPC decisions include a 1982 comprehensive political and ideological study that set RWU goals for all segments of the economy, the development of 119 RWU concepts to aid in planning and management, the establishment of annual RWU plans for industrial companies, preparation of a document pertaining to all relevant government agencies on goals for research and development, institution of government standards for industrial water use, and, by the end of 1982, reduction in specific water demand in 1981 plus 1982 of 8%, rise of not more than 1% in water demand for all areas of the economy, absolute industrial water demand decrease since 1980 of 100 million cu m (with some industries performing much better than others), reduction in wastewater pollution in 1982 of 615,000 population equivalents, increases in water supply of 28.5 and 74.2 million cu m for surface and groundwater, respectively. Future efforts will concentrate on further reductions in water demand (especially in those industries that have not performed well so far), establishment of control procedures, and development of government standards for recycling valuable chemicals. (Gish-IVI)
W84-04793

KDT INFORMATION CONFERENCE ON ECONOMIC EVALUATION OF REDUCTION OF THE WASTEWATER LOAD ON WATER RESOURCES (INFORMATIONSTAGUNG DER KDT ZUR OKONOMISCHEN BEWERTUNG DER ABWASSERLASTSENKUNG IN DEN GEWASSERN),
For primary bibliographic entry see Field 5D.
W84-04794

ECONOMIC EVALUATION OF WATER-MANAGEMENT PROCEDURES FOR THE IMPLEMENTATION OF RATIONAL WATER USE AND WASTEWATER LOAD REDUCTION FOR WATER RESOURCES (VOLKSWIRTSCHAFTLICHE BEWERTUNG WASSERWIRTSCHAFTLICHER MASSNAHMEN ZUR DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG UND ABWASSERLASTSENKUNG IN DEN GEWASSERN),
D. Bohler.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 150-152, May, 1983. 4 Tab, 3 Ref.

Descriptors: *Water management, *Economic aspects, *Water use, Mathematical equations, Economics, Political aspects, Wastewater load reduction, Social aspects.

Water-management procedures (WMP) must be economically evaluated because every utilization made of water resources has an impact on subsequent utilizations. Not operational effectiveness, but effectiveness with regard to the political economy, should be the deciding factor in the order of precedence and sequence of operation of WMP. However, every economic evaluation must be based on scientific evaluation of the water in its environment and its potential use. Mathematical equations are given to quantify economic benefits (based on increased results for the political economy and for the business, taking influencing factors into account), economic effect of operating expenses (increases in economic results over decreases in economic results), and economic effect on one-time expenditures (one-time expenditures over economic results increase determined by the first equation). The final evaluation is based on the results of the equations plus a judgment of nonquantifiable verbal criteria: comparison of equation results with given norms, results from other similar procedures, and optimal values; and estimation of the procedure's effects on partly or nonquantifiable political, military, social, cultural, economic, and scientific criteria (e.g., public health, ensuring an adequate water supply, improvement of working and living conditions of workers, raising water self-purification potential, plant automation). (Gish-IVI)
W84-04795

INCENTIVES AND DISINCENTIVES FOR WATER CONSERVATION IN THE CALIFORNIA STATE WATER POLICYMAKING PROCESS,
California Univ., Los Angeles. Dept. of Political Science.
A. Engelbert, and J. Munro.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 171123, Price codes: A10 in paper copy, A01 in microfiche. Completion Report, January, 1984. 171 p, 7 Fig, 4 Append. Project No. OWRT C-90175-C (0408) (1), Contract/Grant No. 14-34-0001-0408.

Descriptors: *California, *Water conservation, Political aspects; Policymaking; *Institutional constraints; Alternative water use; *Administrative decision, *Decision making, Water policy, *State government, Incentives, Disincentives.

This study focuses on California's political and policymaking environment for water conservation with particular emphasis on the years 1977 through 1980. The major approaches to water conservation are examined in the setting of California's major political conflicts. The positions taken by major interest groups on significant water conservation issues are assessed. The distinctive aspects of the legislative organization and process for water conservation are examined in the context of four major voting blocs. The major pieces of water conservation legislation for the 1977-1980 period are analyzed in terms of educative, incentive, regulatory and institutional change strategies. Finally, the role of the governor in the water conservation policymaking process is highlighted. How California proceeds with its political decisionmaking processes for water conservation has major implications for national and state water policies in the semi-arid West.
W84-04882

3E. Conservation In Industry

RESULTS OF THE IMPLEMENTATION OF THE DIRECTIVE ON RATIONAL WATER USE IN THE 1981-1985 FIVE-YEAR PLAN (ERGEBNISSE BEI DER VERWIRKLICHUNG DER DIREKTIVE ZUR RATIONELLEN WASSERVERWENDUNG IM FUNFJAHRPLAN 1981 BIS 1985),
Ministerium fuer Umweltschutz and Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 3D.
W84-04793

ECONOMIC EVALUATION OF WATER-MANAGEMENT PROCEDURES FOR THE IMPLEMENTATION OF RATIONAL WATER USE AND WASTEWATER LOAD REDUCTION FOR WATER RESOURCES (VOLKSWIRTSCHAFTLICHE BEWERTUNG WASSERWIRTSCHAFTLICHER MASSNAHMEN ZUR DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG UND ABWASSERLASTSENKUNG IN DEN GEWASSERN),
For primary bibliographic entry see Field 3D.
W84-04795

EVALUATION OF OPERATIONAL PROCEDURES FOR THE IMPLEMENTATION OF RATIONAL WATER USE FROM THE POINT OF VIEW OF AN INDUSTRIAL PLANT (BEWERTUNG BETRIEBLICHER MASSNAHMAN FUR DIE DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG AUS DER SICHT EINES INDUSTRIEBETRIEBES),
VEB Papier und Kartonwerke, Schwedt an der Oder (German D.R.).
H. Biernath.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 155-156, May, 1983. 3 Fig.

Descriptors: *Water conservation, *Pulp and paper industry, Industrial water, Water use, Recycling, Water reuse, Filtration, Wastewater treatment, Water use.

The Schwedt VEB Paper and Cardboard Works, German Democratic Republic (GDR), is one of the largest water users (47,000 cu m/day) in the Frankfurt (Oder) District. In paper manufacturing valuable materials, i.e., fiber, are recycled through filtration; the filter cake, when dried, is used for paper/card. At Schwedt, water is circulated three times. In the primary cycle, the filtrate is reused without further treatment. In the second cycle, sedimentation (skimmer) or flotation occurs with chemical supplements, and the resulting solid materials are returned to production, while the water goes to the sewer. In the third cycle, wastewater is treated in a sedimentation facility (funnel), after which the procedure is the same as in cycle two. Schwedt is the largest user of recycled paper in the GDR at 400 tonnes/day, and this presents special wastewater treatment problems. The morphological structure of single fibers in suspended recycled paper is such that a high proportion of dust and slime appears in wastewater and overloads the treatment facility. Its components, such as plastic, foil, wire, wood, cause pollution in the plant water circulation and hinder the reuse of wastewater. In 1979, the plant began a study of its water management in order to formulate a concept for future development. It was decided that the criterion for wastewater treatment should not be simply the avoidance of penalty payments but considerations of technology, sewer requirements, and downstream water users. (Gish-IVI)
W84-04796

3F. Conservation In Agriculture

VERIFICATION OF LATERAL PERCOLATION LOSSES FROM IRRIGATED RICE FIELDS BY A NUMERICAL MODEL,
Land Resources Development Centre, Surbiton (England).
S. H. Walker, and K. R. Rushton.
Journal of Hydrology, Vol. 71, No. 3/4, p 335-351, March, 1984. 6 Fig, 4 Tab, 21 Ref.

Descriptors: *Lateral percolation, *Water loss, *Numerical models, *Rice fields, *Irrigation practices, Irrigation efficiency, Percolation, Percolating water, Bunds, Groundwater movement, Groundwater level, Geohydrology.

Previous field studies have identified lateral percolation as the main cause of low water-use efficiency in certain irrigated rice fields. The mechanism and magnitude of flow through the bund and in the underlying aquifer for a representative problem are examined. A numerical model is used to simulate the flow conditions. The electrical analogue provides a numerical model of lateral percolation from irrigated rice fields which can explain the wide range of seepage and percolation rates reported by field observers, often working under apparently similar conditions. The rates can vary not only with soil texture, but also with depth of water in the fields and seasonal fluctuations of the regional water table. Thus the same site may lose different amounts of water at different times of the year; clay soils with a low water table may lose as much as freely drained soils with a high water table; and high or rapidly rising water tables may also cause the very low, zero or even negative losses usually attributed to artesian conditions. In particular, the model demonstrates the mechanism whereby large losses through bunds do occur and this lateral percolation is seen to be a complex function of hydraulic head and bund geometry which merits further study. In the laboratory, different approaches may be needed to model Bouwer's fringe and partially saturated effects in both the bund and the aquifer, but different bund geometries can be tested using existing numerical models. In the field, additional careful measurements are needed to test water-table positions at crucial points in the bund and aquifer, and to determine whether pressure is atmospheric beneath the rice fields. Although the results do not cover every situation, they offer a coherent and logical explanation for reported field losses, and provide an understanding of the important processes. They show in particular that the very low efficiencies frequently observed on irrigation systems might be substantially improved by better water-management practices at both the tertiary and farm levels. Wastage by lateral percolation could be greatly reduced by maintaining shallow depths of water in the rice fields. (Murphy-IVI)
W84-04867

EVAPOTRANSPIRATION LOSSES OF TOMATOES UNDER DRIP AND FURROW IRRIGATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. O. Pruitt, E. Fereres, D. W. Henderson, and R. M. Hagan.
California Agriculture, Vol. 38, No. 5-6, p 10-11, May-June, 1984. 2 Fig, 2 Tab. OWRT Project A-076-CAL and Water Resources Center Project UCAL-WRC-W-572.

Descriptors: *Furrow irrigation, *Evapotranspiration, *Drip irrigation, Crop yield, Tomatoes, Irrigation, Water conservation, Cost analysis.

During the 1979-1980 growing seasons, a study was conducted to measure evapotranspiration of processing tomatoes under drip and furrow irrigation. The drip-irrigation system consisted of microtube emitters with an inside diameter of 0.035 inch placed every 18 inches on the laterals, each delivering about 0.7 gallon per hour. In the 1980 season, evapotranspiration in the furrow-irrigated lysimeter averaged 30% higher for the first day or two after an irrigation, but, from the fifth day on, it was about 10% higher in the drip-irrigated lysimeter. Drip irrigation has been shown to be capable of increasing yields beyond those achieved by surface irrigation methods under some conditions. This was apparently the case in the 1979 field study, when the drip-irrigated plots yielded 19% more ripe fruit than furrow-irrigated plots. For row crops, the possibility of reducing evaporation losses from soil by using drip irrigation is quite small, although improvements in buried drip systems that do not wet the soil surface may offer additional savings. For most agricultural soils, however, the reduction in evaporation losses alone by changing to drip does not justify the economic investment necessary, because the yield achievable with drip irrigation will not be substantially higher than yield under a well managed surface irrigation system. (Baker-IVI)
W84-04888

NFLUENCE OF WINDBREAK-SHELTER ON OYBEAN PRODUCTION UNDER RAINFED CONDITIONS,
Nebraska Univ.-Lincoln. Dept. of Forestry, Fisheries and Wildlife.
. N. Ogbuehi, and J. R. Brandle.
Agronomy Journal, Vol. 73, No. 4, p 625-628, uly-August, 1981. 2 Fig, 5 Tab, 15 Ref.

Descriptors: *Crop yield, *Water use efficiency, Windbreaks, *Nebraska, Shelterbelts, Wind, Soybeans, Evaporation, Water use.

Wayne soybeans were planted on 19 May during 1978 and 1979 growing seasons under windbreak sheltered and exposed conditions. Shelter from the wind was provided by a system of east-west oriented shelterbelts, 6 m high, 60% dense, and consisting of green ash, Austrian pine, and eastern red cedar. The prevailing winds in Nebraska during the summer study months come mainly from the south. The soil was a Typic Argiudoll. There were no statistically significant differences between treatments in available soil water and plant water use. The main effect of the windbreak was reduction of surface windspeed in the sheltered zone, causing changes in the microclimate that have been proven conducive to improved crop growth and yield. Shelter increased bean yield above that of the exposed plants by 20 and 26% in 1978 and 1979, respectively. Under rainfed conditions, increased water use efficiency and significant increases in bean yield can be expected from windbreak sheltered soybeans. (Baker-IVI)
W84-04965

CANOPY TEMPERATURES, WATER USE, AND WATER USE EFFICIENCY OF CORN GENOTYPES,
Kansas Agricultural Experiment Station, Manhattan. Evapotranspiration Lab.
For primary bibliographic entry see Field 2I.
W84-04966

INFLUENCE OF IRRIGATION AND RHIZOBIUM JAPONICUM STRAINS ON YIELDS OF SOYBEANS GROWN IN A LAKELAND SAND,
Idaho Univ., Moscow. Dept. of Plant and Soil Sciences.
R. L. Mahler, and A. G. Wollum, II.
Agronomy Journal, Vol. 73, No. 4, p 647-651, July-August, 1981. 2 Fig, 7 Tab, 24 Ref.

Descriptors: *Soybeans, *Irrigation effects, *Crop yield, Soil-water-plant relationships, Rhizobium, Soil texture, Soil water.

Under existing management technology, Lakeland sands (Typic Quartzipsamments) produce low yields of soybeans (Glycine max (L.) Merr.) in North Carolina. These soils have an available water holding capacity of only 4.0% on a weight basis and as a result require about 2.5 cm of water every 5 to 6 days during the growth season to produce acceptable crop yields. In addition, Lakeland sands usually have extremely low or a totally nonexistent indigenous population of Rhizobium japonicum. Information on irrigation and nodulation effects is needed to make these soils more productive. The objectives of this study were to investigate the influence of irrigation and inoculation with different R. japonicum strains on yields of soybeans grown in a Lakeland sand. The study was conducted at the Sandhills Research Station at Jackson Springs, North Carolina. Additional nonirrigated plots inoculated with strains 31, 110, and 122 were initiated on finer textured North Carolina soils for comparative purposes to the Lakeland sand. Soil moisture treatments included plots not irrigated and plots irrigated each week with 2.5 cm of water. The five inoculation treatments consisted of a set of noninoculated plots and plots inoculated with strains of R. japonicum representing serogroups 31, 76, 110, and 122 at the rate of 5,000,000 cells per cm of soybean row. Numbers of soil rhizobia were monitored throughout the study using a plant infection and MPN technique. Irrigated soybean seed yields were significantly greater when inoculated with rhizobia of either serogroup 110 or 122 than yields from noninoculated but irrigated plots. Inoculation without irrigation did not increase soybean yields. It was also observed that inoculated, irrigated soybeans had greater nodule mass and numbers of nodules than the nonirrigated and/or noninoculated plots. All four serogroups used in the study adequately nodulated soybean roots under irrigation and produced fewer nodules on soybean roots in the nonirrigated plots. On the basis of seed yield, strain ranking from best to worst was: 122 > 110 > 31 > 76. The noninoculated controls yielded higher than serogroup 76 but less than those soybeans in plots inoculated with serogroup isolate 31. (Author's abstract)
W84-04967

WATER MANAGEMENT AND NITROGEN FERTILIZATION OF RATOON CROP RICE,
Louisiana State Univ., Crawley. Rice Experiment Station.
D. B. Mengel, and F. E. Wilson.
Agronomy Journal, Vol. 73, No. 6, p 1008-1010, November-December, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Water management, *Fertilizers, *Rice, *Ratoon cropping, Flood irrigation, Crop yield.

Ratoon cropping is the practice of obtaining a second crop from tillers originating from the stubble of a harvested crop. Ratooning of rice offers a unique opportunity to maximize the use of land during a growing season which is too short to grow two planted crops, or to utilize residual soil moisture in both irrigated or dry land tropical areas. Field experiments were conducted for 3 years to determine the effect of two water management systems and N fertilization on the yield and milling quality of ratoon crop rice. The experiments were conducted on a Crowley silt loam (Typic Albaqualf) soil. Applying a shallow (5 to 8 cm) continuous flood immediately after harvest of the planted crop was superior to a series of short-term floodings to provide adequate moisture for regrowth, followed by a continuous flood when the ratoon tillers were 10 to 15 cm tall (approximately 4 weeks after planting). Grain yield averaged 68% higher where the immediate flood was applied. Under both water management regimes a significant increase in plant height and grain yield was observed when N fertilizer was applied. Time of flooding and N fertilization had no effect on milling quality of the ratoon crop. (Moore-IVI)
W84-04972

ALFALFA YIELD AND WATER USE WHEN FORCED INTO DORMANCY BY WITHHOLDING WATER DURING THE SUMMER,
Agricultural Research Inst., Nicosia (Cyprus). Soils and Water Use Section.
C. Metochis, and P. I. Orphanos.
Agronomy Journal, Vol. 73, No. 6, p 1048-1050, November-December, 1981. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Alfalfa, *Crop yield, *Water use efficiency, *Dormancy, *Cyprus, Irrigation efficiency, Air temperature, Water conservation.

Under the hot (air temperature reaching 40 C) and dry conditions of the inland areas of Cyprus, alfalfa (Medicago sativa L.) yields decline markedly in July to August. Water-use efficiency (kg DM/cu m of water taken up) decreases from 2.25 to 2.85 in March through May to 0.05 to 0.65 kg/cu m in July through August. This study evaluated several alternatives for increasing water-use efficiency for alfalfa production. Not irrigating the alfalfa for one growth period in July reduced yield during that period by 68%. However, not irrigating for a second or a third growth period resulted in no forage yield during these periods. When irrigation was resumed, plots not irrigated for one or two growth periods yielded as much as plots irrigated at all growth periods, but plots not irrigated for three growth periods produced 20% less yield during the first period following resumption of irrigation. In the following growth periods, however, these yielded as much as plots irrigated at all growth periods. Discontinuing irrigation for the three growth periods of July to August reduced annual dry matter yield to 17,700 kg/ha compared to 21,500 kg/ha when adequate water was applied throughout, but saved 610 mm of irrigation water out of a normal annual irrigation requirement of 1,400 mm. As a result, water-use efficiency in 1978-1979 increased from 1.32 kg DM/cu m of water taken up when adequate irrigation was applied throughout the growing season to 1.60 when irrigation was withheld for the three growth periods of July to August. The corresponding figures for 1979-1980 were 1.41 and 1.81, respectively. (Author's abstract)
W84-04974

CONSUMPTIVE WATER USE BY SUB-IRRIGATED TURFGRASS UNDER DESERT CONDITIONS,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
W. R. Kneebone, and I. L. Pepper.
Agronomy Journal, Vol. 74, No. 3, p 419-423, May-June, 1982. 4 Fig, 3 Tab, 9 Ref. OWRT project B-035-WYO.

Descriptors: *Consumptive use, *Water use, *Turf grasses, *Subirrigation, *Deserts, Arid lands, Climate, Evaporation demand, Irrigation practices, Water table.

Irrigation is essential for turfgrass growth in the arid southwest. Water conservation is equally essential. To irrigate properly, levels of consumptive water use and the factors which affect them must be known. This study evaluated effects of management, local climate, species, and cultivars upon water use. Three bermudagrasses (Cynodon dactylon L. Pers.), a zoysiagrass (Zoysia japonica Steud.), St. Augustinegrass (Stenotophrum secundatum (Walt.) Kuntzel), and tall fescue (Festuca arundinacea Schreb.) were grown in a local washed mortar sand in percolation lysimeters with measured subirrigation at Tucson, Ariz. There were no significant differences in consumptive water use among the bermudagrasses and zoysiagrass at either of two managements. Raising the water table 10 cm and overseeding with annual ryegrass in winter significantly increased consumptive use. St. Augustinegrass and tall fescue used significantly more water than the bermudagrass and zoysiagrass. Consumptive water use varied with evaporative demand as measured by Class A pan. Consumptive use values expressed as percentage of evaporative pan losses ranged from 42 to 80% depending upon management and grass. Mean annual percentages were 46 for bermudagrasses and zoysiagrass, 58 for St. Augustinegrass, and 64 for tall fescue grown with the same water table. The same percentage was 58 for bermudagrasses and zoysiagrass overseeded with ryegrass in winter and maintained with a 10 cm higher water table. (Author's abstract)
W84-04983

RESPONSE OF TOMATOES TO N AND WATER APPLIED VIA A TRICKLE IRRIGATION SYSTEM. II. WATER,
Agricultural Research Organization, Bet-Dagan (Israel). Div. of Soil Chemistry and Plant Nutrition.
B. Bar-Yosef, and B. Sagiv.
Agronomy Journal, Vol. 74, No. 4, p 637-639, July-August, 1982. 4 Fig, 6 Ref.

Descriptors: *Trickle irrigation, *Tomatoes, *Crop yield, Irrigation rate, Soil water potential, Crop management, Nitrogen, Evaporation.

The objective of the study was to relate tomato fruit yield and N uptake to water application rates via a trickle irrigation system at given N rates to total water potential in the soil root volume. This information is needed to improve tomato cropping management under point source irrigation. The experiments were conducted on sandy soils at three different locations in Israel and included combinations of several daily N and water application rates, and two irrigation intervals. Fruit yield responded linearily to increasing total irrigation rates (Qw) up to 80% of the accumulated evaporation from a U.S. Class A pan (Ep), the slope of the response line being 15 metric tons/ha for each 10% change in Qw/Ep. The optimum average N concentration in the irrigation solution was determined

to be 130 ppm N, below which yields and growth were inhibited and above which the soil water potential (Theta) decreased, thus increasing the dry matter content of the fruit. A decrease in Theta from -50 to -150 centibars appreciably decreased fresh fruit yield; a further decrease in Theta caused a slower decrease in fresh fruit yield. (Author's abstract)
W84-04985

FORAGE CORN RESPONSE TO SEVERAL TRICKLE IRRIGATION AND FERTILIZATION REGIMES,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
M. Yanuka, Y. Leshem, and A. Dovrat.
Agronomy Journal, Vol. 74, No. 4, p 736-740, July-August, 1982. 7 Fig, 3 Tab, 29 Ref.

Descriptors: *Trickle irrigation, *Corn, *Fertilizers, Forages, Evapotranspiration, Irrigation effects, Crop yield, Soil water.

Trickle irrigation has the advantages of better water and nutrient control (frequent supply as needed by the plant) and less outside disturbance that may cause lower water and nutrient use efficiencies (wind, loss of pressure in irrigation pipes). The yield level of forage corn (Zea mays L.), cv. Newe Ya'ar 170 at a density of 110,000 plants per hectare, and its nutrient and moisture uptake were determined, as affected by the application of different amounts of irrigation water when plant nutrients in the soil were sufficient for maximum growth. Crop water requirement (WR) was based on estimates of ET/Eo (ET = crop evapotranspiration and Eo = Class A pan evaporation) multiplied by Em (measured Class A pan evaporation). In order to derive the different irrigation treatments, WR was multiplied by a variable K, i.e., 1.5, 1.0, or 0.5, giving the total amounts of water applied by trickles of 693, 459, or 230 mm, respectively over an experimental period of approximately 100 days. The averages of daily water tension in several soil profiles, daily dry matter production rates, cummulative dry matter yield, and daily nutrient (N, P, K) uptake by the plant were measured. The ratio between dry matter yield and ET/Eo was approximately 290 kg/ha/day for all treatments. This value is high in comparison with those reported in the literature. The response curve of dry matter yield vs. evapotranspiration began near the origin and was linear. The maximum dry matter yield, 32,440 kg/ha, was obtained with an average soil water tension of 4 centibars at 0 to 150 cm soil depth and average NO3-N concentration of about 80 ppm in soil solution to a depth of 30 cm during the period of most active N uptake. Average P and K concentrations in the upper 30 cm at that time were 20 and 80 ppm, respectively. The maximum rate of dry matter production was 660 kg/ha/day at the time of grain filling. Trickle irrigation allowed efficient control of the fertilizer-water-soil system, maintaining high water and nutrient availability to the crop. (Moore-IVI)
W84-04987

MOISTURE DEFICITS AND GRAIN SORGHUM PERFORMANCE: EFFECT OF GENOTYPE AND LIMITED IRRIGATION STRATEGY,
International Rice Research Inst., Los Banos, Laguna (Philippines). Dept. of Agronomy.
D. P. Garrity, D. G. Watts, C. Y. Sullivan, and J. R. Gilley.
Agronomy Journal, Vol. 74, No. 5, p 808-814, September-October, 1982. 6 Fig, 3 Tab, 13 Ref.

Descriptors: *Sorghum, *Irrigation effects, *Water stress, Crop yield, Drought resistance, Water allocation, Irrigation timing, Water conservation.

The response of three selected sorghum (Sorghum bicolor (L.) Moench) hybrids to a wide range of timings and intensities of drought stress were studied in field experiments on a sandy soil (Typic Ustipsament) in west central Nebraska. A modified line source sprinkler irrigation gradient was used to create the treatments. Yield reduction (41 to 45%) resulting from the gradual intensification of stress over the entire season were large but very similar among genotypes. Greater genotypic differences occurred in treatments in which irrigation was limited during only one or two growth periods. The genotypic rankings for yield were quite consistent over the range of treatments, with the hybrid of highest yield potential (RS 626) usually continuing to demonstrate superior yields under drought stress. The hybrid (NB 505) of lowest yield potential did not show a comparatively greater drought resistance (i.e., a lower percentage yield reduction) under severe stress. Grain yield tended to be linearly related to seasonal net water application and to various in the percent of the soil water deficit that was replaced each week, regardless of variety or the growth stage(s) at which irrigation was limited. The timing of irrigation was quite critical with large differences in the response of each hybrid to the same quality of seasonal water applied under varying strategies. The data for both years and all genotypes indicated that an optimal strategy for allocating water under limited irrigation would be to apply a constant fraction of the crop's maximum water usage each week, allowing stress to gradually and progressively intensify throughout the season. Yield reductions will occur but these will tend to be lower per unit of irrigation water saved than when irrigation is limited only in individual growth periods. (Author's abstract)
W84-04988

MOISTURE DEFICITS AND GRAIN SORGHUM PERFORMANCE: EVAPOTRANSPIRATION-YIELD RELATIONSHIPS,
For primary bibliographic entry see Field 2D.
W84-04989

EFFECTS OF PLANT AND ROW SPACING ON DRYLAND SOYBEAN YIELD AND WATER-USE EFFICIENCY,
Science and Education Administration, Mandan, ND. Northern Great Plains Research Center.
J. Alessi, and J. F. Power.
Agronomy Journal, Vol. 74, No. 5, p 851-854, September-October, 1982. 3 Fig, 3 Tab, 18 Ref.

Descriptors: *Soybean, *Water use efficiency, *Crop yield, *Row spacing, *Plant spacing, Drought, Soil water, Available water, Water stress.

The question of water availability and water use rate, as affected by planting geometry, becomes of major significance to soybean production in drier regions or drier years. In such situations, water availability may assume greater importance than availability of solar radiation in limiting the growth of most crops. Each spring, 1976 through 1979, soybeans were seeded on Temvik silt loam (fine-silty, mixed Typic Haploborolls) at Mandan, N.D., in row widths of 15, 45, and 90 cm, and at within-row spacings of 11, 15, and 23 cm, which resulted in plant populations of 48,000 to 580,000 plants/ha. Soil water depletion by soybeans was generally confined to the upper 90-cm soil depth. Average (4-year) water use was 23.6 cm, and was not significantly affected by plant spacing. In 2 of the 4 years, total water use was greatest and average soybean yields were least from the 15-cm row width. Within-row spacing affected yields in only 1 of the 4 years. Water-use efficiency was least for 15-cm rows in 3 of the 4 years. Planting in 15-cm rows enhances water use prior to flowering. In extreme drought situations, this enhanced early-season water use leaves less water available for pod-fill, and seed yields may be reduced accordingly. Under less severe water stress, plant and row spacing has no affect on soybean yield. Narrow rows may be beneficial for soybean production when water is not restricted; may have no effect upon soybean yields when moderate water stress is encountered; and may reduce soybean yields under extreme water stress situations. (Moore-IVI)
W84-04990

RESPONSE OF DRIP-IRRIGATED SUGARCANE TO DROUGHT STRESS,
Lihue Plantation Co. Ltd., Kauai, HI.
P. H. Koehler, P. H. Moore, C. A. Jones, A. D. Cruz, and A. Maretzki.
Agronomy Journal, Vol. 74, No. 5, p 906-911, September-October, 1982. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Drip irrigation, *Sugarcane, *Drought stress, *Hawaii, Crop yield, Plant water potential, Soil water, Plant growth, Irrigation requirement.

Though drip irrigation is used on more than half of the irrigated sugarcane (Saccharum spp. hybrid) in Hawaii, the effects of drought stress on the growth and yield of drip-irrigated sugarcane has not been investigated extensively. This study reports the effects of a single period of drought stress on the growth and metabolism of cultivar H62-4671 during vegetative growth in drip-irrigated fields during the 1st year of a normal 2-year crop in five fields at Kekaha Sugar Company, Kauai, Hawaii. The plants ranged from 5.4 to 9.8 months of age at the beginning of the experiment. Water depletion from the soil profile, leaf water potential (Psi l), leaf solute potential (Psi pi), leaf pressure potential (Psi rho), stalk elongation, plant sugar, K, and amino acid concentrations were monitored at 1200 to 1400 hour during a 5- or 6-week period of drought stress. In three of four fields, soil water extraction was limited by low soil water content after cumulative profile water depletion of approximately 120 mm. Stalk elongation was strongly correlated to Psi l and cumulative soil water depletion. Stalk elongation of plants in drought-stressed plots was less than 80% that of plants in well-watered plots after only 50 mm of cumulative soil water depletion. During drought the concentration of potassium and reducing sugars in the leaf blade increased, but the concentrations of sucrose and free amino acids changed little. None of these metabolites changed in the stem appex. The results indicate that a serious reduction in stalk elongation occurs prior to a reduction in the rate of soil water depletion, a change in the false-color infrared signature of the canopy, or large changes in Psi l, Psi pi, leaf and meristem sugar, K, and amino acid concentrations. The results emphasize the importance of maintaining normal irrigation intervals with drip-irrigated sugarcane cv. H62-4671. (Author's abstract)
W84-04991

EFFECT OF CROP RESIDUE MANAGEMENT AND TILLAGE ON WATER USE EFFICIENCY AND YIELD OF WINTER WHEAT,
Agricultural Research Service, Pullman, WA.
V. L. Cochran, L. F. Elliott, and R. I. Papendick.
Agronomy Journal, Vol. 74, No. 6, p 929-932, November-December, 1982. 1 Fig, 4 Tab, 15 Ref.

Descriptors: *Wheat, *Tillage, *Water use efficiency, *Crop yield, *Residue management, Phytotoxins, Water storage, Drill seeding.

Direct drilling of winter wheat (Triticum aestivum L.) into surface cereal residues reduces soil erosion but frequently has resulted in stunted plants and lower grain yields than conventional planting methods. Phytotoxins produced during decomposition of surface crop residues have been implicated as the cause of these reduced yields. Field plots were established on spring and winter wheat stubble to compare plant stands, water storage, grain yields, and water-use efficiency between direct drill seeded and conventionally seeded winter wheat. Residue management treatments included: standing stubble, complete residue removal, moving the crop residue from the seed row, and residue incorporation. New sites were used each year with the spring and winter wheat stubble maintained on Naff silt loam (fine-silty, mixed, mesic Ultic Argixerolls) and Palouse silt loam (fine-silty, mixed, mesic pachic Ultic Haploxerolls), respectively. Water soluble phytotoxins from the surface crop residues were not found during the 3-year study. Furthermore, moving the crop residues from the seed row did not affect yields, but did alleviate the high crown node set which in turn reduced visual injury from soil active herbicides. Surface crop residues significantly improved water storage during the one season with a major runoff event, which increased grain yields and water use efficiencies, but had no effect when soil profiles were filled by spring. During the 3-year study,

winter wheat yields from plots direct drilled into surface cereal residues were equal to those from plots tilled and seeded conventionally. (Author's abstract)
W84-04992

KENTUCKY BLUEGRASS GROWTH AND WATER USE UNDER DIFFERENT SOIL COMPACTION AND IRRIGATION REGIMES,
Kansas State Univ., Manhattan. Dept. of Horticulture.
K. J. O'Neil, and R. N. Carrow.
Agronomy Journal, Vol. 74, No. 6, p 933-936, November-December, 1982. 3 Tab, 25 Ref.

Descriptors: *Turf grasses, *Water use efficiency, *Soil compaction, *Irrigation efficiency, Plant growth, Aeration porosity, Soil physical properties, Soil water, Water retention.

Soil compaction and efficient use of irrigation water are important concerns of turfgrass managers. This field study examined effects of soil compaction on growth and water utilization of a cool-season turfgrass species under different irrigation programs. A 2-year-old stand of Poa pratensis L., 'Baron,' on a fine, montmorillonitic mesic Aquic Arguidoll soil, was subjected to four treatments resulting from a factorial design with two levels of compaction (none and 30 passes per week with roller) and two levels of irrigation (set schedule of 3.8 cm water per week plus rainfall and 3.8 cm when tensiometer at 10 cm depth read -0.70 bar). Soil compaction had no effect on root weight or distribution. Visual quality, shoot density, verdure, and percent total cover were reduced by compaction while total nonstructural carbohydrates (TNC) were unaffected. In the surface 3 cm of soil, compaction increased bulk density and moisture retention but reduced aeration porosity at -0.1 bar from 18.1 to 12.5%. Irrigation treatment had no effect on any of the soil physical properties. Without affecting turf quality, water use with tensiometer was reduced by 28 and 48% on noncompacted and compacted areas, respectively, compared to set-schedule irrigated plots. Water use over a 9-day period in August indicated that the turf grown under the tensiometer scheduled regime was physiologically or anatomically adapted to use less water even when it was available. This adaptation was not due to differences in vegetative or root growth in this study. Compaction reduced water use by 20% over the 4 month study. During a 9-day period in August, compaction reduced water use by 3.5 to 11% for the tensiometer and set-scheduled treatments, respectively. This response appeared to be due primarily to altered moisture retention properties and reduced shoot growth. Thus, compacted and noncompacted sites should be irrigated on separate schedules. (Author's abstract)
W84-04993

EFFECT OF IRRIGATION AND ROW SPACING ON SOYBEAN WATER USE,
Agricultural Research Service, Morris, MN.
D. C. Reicosky, H. R. Rowse, W. K. Mason, and H. M. Taylor.
Agronomy Journal, Vol. 74, No. 6, p 958-964, November-December, 1982. 6 Fig, 5 Tab, 10 Ref.

Descriptors: *Irrigation effects, *Row spacing, *Soybean, *Water use efficiency, Crop yield, Soil water, Evapotranspiration, Soil water.

A better understanding of the soil-water plant spacing interactions as they affect water-use efficiency and crop yields requires the development of satisfactory methods for determining water use. The objective of this work was to determine the effect of 25- and 100-cm row spacings on crop water use under irrigated and nonirrigated soybeans (Glycine max (L.) Merr.) on a fine, silty, mixed (calcareous) mesic family of Typic Udorthents soil. Water use was evaluated by measuring evapotranspiration and soil water extraction. Evapotranspiration (ET) was measured using a portable chamber that utilized psychrometric techniques to determine changes in the water vapor density when the chamber enclosed the crop canopy and the soil surface. Soil water extraction (SWE) was calculated from changes in gravimetric water content during periods without rainfall and then corrected for the flow of water at the bottom of the root zone. Irrigation resulted in the expected higher water use rates on both row spacings. The row spacing effect early in the season was related to the leaf area index (LAI). Early in the season, the 25-cm irrigated treatment had a slighly higher ET than the 100-cm irrigated treatment. Later in the season, row spacing effects were not evident. The two methods employed for evaluating crop water use showed only fair agreement. (Author's abstract)
W84-04995

POTATO IRRIGATION REQUIREMENTS IN A HOT CLIMATE USING SPRINKLER AND DRIP METHODS,
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
J. Shalhevet, D. Shimshi, and T. Meir.
Agronomy Journal, Vol. 75, No. 1, p 13-16, January-February, 1983. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Potato, *Irrigation requirements, *Sprinkler irrigation, *Drip irrigation, *Israel, Evaporation, Irrigation efficiency, Arid climates, Crop yield, Water potential.

Potato (Solanum tuberosum L.) is a heat- and drought-sensitive crop, which in hot climates usually requires large water applications for optimum production. Irrigation water in Israel is both limiting in quantity and high in price; thus it is critical to know the water requirement of the crop, as well as how to improve irrigation efficiency. Field experiments were conducted in the Negev (arid) region of Israel on a Typic Camborthid soil to determine the water production functions of potatoes ('Desiree') under drip and sprinkler irrigation. Irrigation treatments were based on Class A pan evaporation. The linear production functions relating total yield in metric ton/ha to seasonal water application depth (W) in cm were, for sprinkler irrigation: $Y = -23.5 + 1.19\ W$, and for drip irrigation: $Y = -12.8 + 1.14\ W$. Similar total maximum yields were obtained with about 8% less water with the drip as with the sprinkler method (not statistically significant). A single production function for both methods described the yield of marketable tubers: $Y = -40.0 + 1.28\ W$. These functions apply in the relative water application range (water applied over Class A pan evaporation) of 0.3 to 1.0, at which point the function reaches a plateau. Yield was reduced by 12% as soil water potential in the 0 to 0.6 m depth increment changed from -20 to -29 J/kg for sprinkler irrigation. Under drip irrigation the soil could dry to -40 J/kg without yield reduction, as long as the water supply was adequate. This was explained by the higher root concentration under drip than under sprinkler irrigation. (Author's abstract)
W84-04997

DROUGHT RESPONSE OF SORGHUM HYBRIDS UNDER A SPRINKLER IRRIGATION GRADIENT SYSTEM,
Arizona Univ., Tucson.
M. K. O'Neill, W. Hoffman, A. K. Dobrenz, and V. Marcarian.
Agronomy Journal, Vol. 75, No. 1, p 102-107, January-February, 1983. 5 Fig, 3 Tab, 23 Ref.

Descriptors: *Drought resistance, *Sorghum, *Irrigation gradient, Sprinkler irrigation, Arid climates, Hybrids, Water stress, Plant growth.

Reliable techniques for identification of drought-resistant germplasm are essential if new lines and hybrids are to be developed for arid and semiarid areas of the world. This experiment was designed to evaluate the irrigation gradient system as a mechanism for evaluating drought tolerance in sorghum (Sorghum bicolor (L.) Moench.) in the field. Fifty sorghum hybrids which were developed with A-lines 'CK-60' and 'Redlan' were planted perpendicular to the mainline of the sprinkler irrigation gradient system at Yuma, Ariz. in 1979 and 1980. The soil was a superstition sand (sandy, mixed, hyperthermic Typic Calciorthid) with an average available soil moisture of 3.6%. Characteristics including panicle rank, anthesis date, plant height, panicle and peduncle length, crown diameter, and plant weight were measured on plants of each hybrid grown in the high and low water areas of the gradient system. The distance from the line source to the last grain-producing panicle in the low water area of the gradient was also measured on each hybrid. Hybrids developed with CK-60 were able to produce seed-producing panicles in drier areas of the gradient compared to hybrids developed with Redlan. The average distance from the sprinkler line source was 14.4 m for CK-60 hybrids and 11.3 m for Redlan hybrids over both years. Days to anthesis, panicle and peduncle length of plants in the stressed area of the gradient may be potential indicators of drought resistance. The irrigation gradient system is a useful tool for evaluating drough resistance and the selection of parental lines over a wide range of available soil moisture conditions. (Author's abstract)
W84-04999

IRRIGATED CORN YIELD RESPONSE TO NITROGEN AND WATER,
Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
H. V. Eck.
Agronomy Journal, Vol. 76, No. 3, p 421-428, May-June, 1984. 11 Fig, 3 Tab, 18 Ref.

Descriptors: *Corn, *Crop yield, *Irrigation requirements, *Nitrogen, Drought, Water stress, Irrigation timing, Fertilizers, Plant growth, High Plains.

Irrigated corn (Zea mays L.) is a relatively new crop on the Southern High Plains where the groundwater supply for irrigation is declining. Field studies were conducted to determine the plant nutrient needs for corn on a predominant soil of the area, the effects of timing and duration of drought stress periods, and the interacting effects of N levels and drought stress on N nutrition and production of corn. Fertilizer N rates ranged from 0 to 350 kg/ha. Irrigations were applied or deleted to allow the crop to be unstressed (I-1), stressed 2 weeks during late vegetative growth (I-2), stressed 2 weeks during early vegetative growth (I-2a), stressed 4 weeks during vegetative growth (I-3), stressed about 4 weeks during grain filling (I-4), and stressed about 2 weeks during grain filling (I-5). The soil was Pullman clay loam (fine, mixed, thermic Torrertic Paleustolls). Four-year average data (three with graded furrow irrigation, one in level borders) showed that 140 kg N/ha were sufficient for maximum yields. However, simultaneous experiments conducted on graded furrows and level borders showed that while 140 kg N/ha gave maximum yields on graded furrows, 210 kg N/ha were required in level borders. This comparison illustrates the possible fallacy in conducting fertilizer trials under one method of irrigation and extrapolating results to another. Two and 4 weeks of plant water stress during vegetative growth reduced yields of adequately fertilized (210 kg N/ha) corn 23 and 46%, respectively. Two-week stress periods during late (I-2) and early (I-2a) vegetative growth had similar effects on grain yields. Relationships between lengths of stress periods during grain filling and yield showed that yields were reduced 1.2% for each day stress was imposed during grain filling; however, as indicated by the r2 (0.31), there was considerable variation in the data. A N x water stress interation occurred on grain yields. Adequate N slightly increased corn grain yield under stress and greatly increased yield with full irrigation. Excessive N did not reduce yield even with severe water stress, thus, there would be no reason to reduce N rates to reduce water stress. As grain yields increased, the ratio of grain yield to N yield decreased until maximum yields were attained and then remained constant, indicating little luxury consumption of N. At maximum yield, typical grain yield/N yield ratios were about 52:1. At harvest soil NO3(-)-N levels showed that plants had removed most of the N applied at rates up to 140 kg/ha, but increasing amounts remained when N application rates were above 140 kg/ha. (Author's abstract)
W84-05000

OPTIMUM CROP WATER APPLICATION AS AFFECTED BY UNIFORMITY OF WATER INFILTRATION,

J. Letey, H. J. Vaux, Jr., and E. Feinerman.

Agronomy Journal, Vol. 76, No. 3, p 435-441, May-June, 1984. 9 Fig, 21 Ref. California State Water Resources Control Board contract 2-043-300-0.

Descriptors: *Infiltration rate, *Irrigation efficiency, *Corn, *Cotton, *Economic aspects, Crop yield, Uniformity, Costs.

Economic analyses of irrigated agriculture stress that yield levels which maximize profits can be attained with less water than maximum yields. A premise of such analyses is that irrigated soils have perfectly uniform rates of infiltration. A general method for evaluating the effects of nonuniform infiltration rates on optimal levels of water application is developed. Empirical analyses of the implications of non uniform infiltration rates on optimal levels of applied water, yields, and profits are reported for corn (Zea mays L.) and cotton (Gossypium hirsutum L.). The results are critically influenced by the nature of the water yield relationships postulated for these crops. For corn, where excessive water applications apparently have no effect on yield, nonuniform conditions reduce yield and profit. These outcomes can be offset by increasing water applications and optimal levels of applied water increase as the degree of uniformity declines. For cotton, nonuniformity leads to decreases in yields and profits that cannot be offset by increased water applications. This is attributable to the apparent sensitivity of cotton yields to excessive applications of water. For both crops, increases in the price of water provide little incentive to improve the uniformity of infiltration. The results demonstrate that conventional economic analyses which ignore infiltration uniformities, underestimate optimal levels of applied water, often substantially. (Author's abstract)

W84-05001

YIELD AND YIELD COMPONENTS OF 'BRAXTON' SOYBEANS AS INFLUENCED BY IRRIGATION AND INTRAROW SPACING,

Clemson Univ., SC. Dept. of Agronomy and Soils.
E. L. Ramseur, V. L. Quisenberry, S. U. Wallace, and J. H. Palmer.

Agronomy Journal, Vol. 76, No. 3, p 442-446, May-June, 1984. 1 Fig, 3 Tab, 33 Ref.

Descriptors: *Soybean, *Row spacing, *Crop yield, *Irrigation effects, Irrigation timing, Plant growth.

Soybean (Glycine max) yields in the Southeast historically have been lower than those obtained in the Midwest. Irrigation will increase soybean yields in the Southeast, but it is not known whether irrigation throughtout the growing season is more beneficial than irrigation begun at bloom. Yield and yield components of 'Braxton' soybeans, Maturity Group VII, were measured for differing irrigation regimes and intrarow spacings. Prior to the V3 growth stage, plots were thinned to achieve intrarow spacings of 61, 76, 102, 152, 305, and 457 mm in 1980 with spacings of 43 and 51 mm added in the 2nd year. Soil water regimes were full-season irrigation (FSI), irrigation beginning at bloom (BI), and no irrigation (NI). Seed yields for the 2 years, averaged over all spacings, were 3023, 2876, and 1322 kg/ha for the FSI, BI, and NI irrigation treatments, respectively. Yields were increased significantly with irrigation, but no significant difference in yield was measured between FSI and BI treatments. Yields among plant spacings were not significantly different for any irrigation treatment either year with the exception that the yield of the 457-mm spacing of the BI treatment was significantly reduced in 1981. Seed number was highly correlated with seed yield, whereas single seed weight was not significantly correlated with yield. Increases in seed number under the irrigation treatments were due to increases in both pod number and seed per pod. Seed growth rate was increased and effective filling period was decreased by irrigation. Intrarow spacings up to 457 mm had little influence on yield. Full-season irrigation gave no yield advantage over bloom irrigation. (Moore-IVI)

W84-05002

IRRIGATION SCHEDULING I: CROP AND SOIL PARAMETERS,

North Carolina State Univ. at Raleigh. Dept. of Soil Science.
D. K. Cassel.

Crops and Soils Magazine, Vol. 36, No. 5, p 16-20, February, 1984. 4 Fig, 1 Tab.

Descriptors: *Irrigation practices, *Soil properties, Water potentials, Plant growth, Crop yield, Root zone, Soil water, Infiltration, Water table, Runoff.

Soil, crop, and climatic parameters which must be considered in developing an effective and efficient irrigation scheduling method for a particular field include water balance, rooting depth, and available water capacity. As rain falls onto the soil it either runs off, ponds, or infiltrates the soil. As it infiltrates, it is stored at first in the layers of soil closest the surface. If enough rain falls, the water is lost to plant use through deep percolation. If prevented from infiltrating, the water will stand on the surface and evaporate or stand around the roots of the plants, causing damage due to lack of air. One of the keys to effective irrigation is to know precisely the rooting depth of the particular crop. Some soils have barriers that modify the potential rooting depth such as acid subsoils, rock strata, tillage pans, fragipans, clay pans, and caliche. Most agricultural soils drain to in situ field capacity within 1 to 3 days. An additional soil parameter that must be determined is soil bulk density which is the weight of oven dry soil per unit volume of soil. This value is needed to convert the wilting point and in situ field capacity water content data to inches of available water per inch of soil. Available water ranges from 0.02 inch/inch of soil for coarse sand to as much as 0.18 inch/inch of soil for silt loam. (Baker-IVI)

W84-05005

IRRIGATION SCHEDULING II: SIMPLE, LOW COST TECHNIQUES,

North Carolina State Univ. at Raleigh. Dept. of Soil Science.
D. K. Cassel.

Crops and Soils Magazine, Vol. 36, No. 6, p 15-18, March, 1984. 3 Fig. 3 Tab.

Descriptors: *Irrigation practices, *Water stress, Crop yield, Plant growth, Soil water, Irrigation requirements, Allowable depletion, Irrigation efficiency.

The idea of allowable soil water depletion is considered and several simple, relatively low cost irrigation scheduling techniques are proposed. Using these techniques, the irrigator can insure that the crop is not subjected to severe water shortages or that excessive irrigation water is not used. A primary consideration is how dry the crop rooting zone should be allowed to get before irrigation water is needed. Allowable depletion is the percentage of the available water stored in the crop root zone that the crop can use without undergoing severe moisture stress. After establishing the rooting depth of a particular crop on a particular soil, measure the available water capacity in the root zone, and decide to allow the crop to deplete only 50% of the available water. Water applications can then be scheduled using soil measurements, plant measurements or climatological measurements. Feeling the soil at various times and locations throughout the field will give a general knowledge of the amount of available water in the soil. Gravimetric soil sampling requires the collection of soil samples from the root zone at representative locations in the field. A tensiometer can also be used which does not measure directly the amount of water in the soil, but measures soil moisture tension or suction which is the energy that must be exerted by a plant to extract water from the soil. Electrical resistance blocks, commonly called gypsum blocks or moisture blocks, produce a calibration curve showing the relationship between the electrical resistance and soil water content, thus allowing the operator to determine when to irrigate. Moisture blocks work well in fine- and medium-textured soils but are not recommended for sandy soils. (Baker-IVI)

W84-05006

IRRIGATION SCHEDULING III: SOPHISTICATED TECHNIQUES,

North Carolina State Univ. at Raleigh. Dept. of Soil Science.
D. K. Cassel.

Crops and Soils Magazine, Vol. 36, No. 7, p 20-23, April-May, 1984. 3 Fig, 1 Tab.

Descriptors: *Irrigation practices, *Soil water, *Measuring instruments, Infrared thermometer, Neutron meter, Plant growth, Moisture stress, Crop yield.

Sophisticated irrigation scheduling techniques discussed include the neutron meter method, the checkbook method, and use of the infrared thermometer. The neutron moisture meter measures soil water content without collecting individual soil samples. Once the neutron access tubes are installed, the irrigator can repeatedly and reliably determine the soil water content at the same place. The checkbook scheduling method is similar to transfering money into and out of a bank account. Water added to the soil by rainfall or sprinkler irrigation can be measured with rain gauges placed in the field. Withdrawals of water from the crop root zone are through drainage and evapotranspiration. Where the water deposit and withdrawal information is available for a given day, the checkbook can be balanced. The soil water content computed by this method must be periodically (every 2 to 4 weeks) checked against the actual soil water content and the value adjusted. An infrared thermometer is used to measure the intensity of the infrared radiation emitted by an object. When plenty of water is present, healthy plants transpire water at a rate fast enough to satisfy the evaporative power of the incoming solar radiation. In arid or semi-arid regions, the plant undergoes moisture stress when the temperature of the plant leaves or plant canopy is higher than the air temperature. Portability of an infrared thermometer makes it a convenient tool and it costs between $1,000 and $3,500 at present. (Baker-IVI)

W84-05007

WATER STRESS STATUS IN GUAYULE AS MEASURED BY RELATIVE LEAF WATER CONTENT,

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
W. L. Ehrler, and F. S. Nakayama.

Crop Science, Vol. 24, No. 1, p 61-66, January-February, 1984. 7 Fig, 1 Tab, 7 Ref.

Descriptors: *Leaf water content, *Water stress, *Guayule, Soil water deficit, Irrigation effects, Irrigation requirements.

The relative leaf water content (RLWC), defined as the ratio of leaf water content at sampling to that at full turgor, was observed to be a sensitive indicator of soil water deficits for two cultivars of guayule (Parthenium argentatum Gray) in an experiment at Phoenix, Ariz. A year's measurements showed highly significant correlation coefficient values for the linear regression of RLWC on the amount of water in the soil (mm water/170-cm depth of soil). The r values ranged from 0.93 in the dry treatment to 0.78 in the wet treatment of cv. 593, which consistently depleted the soil moisture to lower values than 11591. The RLWC decreased to extremely low values, 30 to 40%, but irrigation restored them to about 75% overnight, accompanied by a gain in leaf area of as much as 30%. The RLWC technique does not require elaborate instrumentation or procedure and may be useful as a guide to irrigation scheduling of guayule. (Author's abstract)

W84-05009

DRIP WATERING SYSTEMS FOR GREAT PLAINS WINDBREAKS,

Soil Conservation Service, Lincoln, NE.
K. A. Ticknor, and D. L. Hintz.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 113-114, March-April, 1984, 2 Fig.

Descriptors: *Drip irrigation, *Windbreaks, Shelterbelts, Great Plains, Trees, Irrigation, Irrigation practices, Water demand, Nebraska, Kansas.

Use of drip watering systems has boomed because the systems provide a simple, efficient, and low-cost means of watering trees and shrubs, particularly useful for windbreaks in the Great Plains. A 60% survival rate is typical for windbreak trees in the Great Plains area with a 30% or less being common for some species. Use of the drip watering systems can improve that survival rate to 90%. Such a system consists of lateral lines, usually one-half-inch polyethylene pipe, placed in each tree row and fitted with a pressure-compensating emitter at each tree. A field review of drip watering systems was made to evaluate six years of their use in Nebraska and Kansas. Variable conditions of soils, weather, site preparation, and weed control have had little effect on survival when supplemental water is supplied by drip watering systems. Trees and shrubs should be watered at least once per week during the first year after planting. Four to 10 gallons of water should be applied per plant per watering. Site preparation and weed control had more effect on growth than watering. (Baker-IVI)
W84-05055

RESPONSE OF SQUASH TO IRRIGATION, NITROGEN FERTILIZATION, AND TILLAGE SYSTEMS,
Georgia Coastal Plain Experiment Station, Tifton.
For primary bibliographic entry see Field 2I.
W84-05062

EFFECTS OF RAINFALL AND IRRIGATION MANAGEMENT ON CITRUS JUICE QUALITY IN TEXAS,
Agricultural Research Service, Weslaco, TX.
For primary bibliographic entry see Field 2I.
W84-05064

EFFECT OF REDUCED WATER SUPPLY ON PEACH TREE GROWTH AND YIELDS,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
P. D. Mitchell, and D. J. Chalmers.
Journal of the American Society of Horticultural Sciences, Vol. 107, No. 5, p 853-856, 1982. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Water conservation, *Peaches, *Irrigation efficiency, Trickle irrigation, Evaporation, Plant growth, Crop yield.

A range of irrigation levels was compared in specific periods of fruit development to determine their suitability for control of tree vigor and yields in ultra-dense orchards of peach (Prunus persica L. Batsch) trees. Where trees in the 3rd leaf were trickle-irrigated with 4 levels (100, 50, 25, and 12.5%) of replacement of Eps (evaporation over the planting square) during the period of rapid vegetative growth, both frame and fruit growth declined as irrigation quantity decreased. In the following period of maximum fruit growth, 130% of Eps replacement increased vegetative growth but not fruit growth compared to 100% Eps. The fruit, however, grew faster in this period on those trees which had received low levels of Eps replacement in the earlier period of maximum vegetative growth. The net result was similar final fruit size and yield between treatments, combined with control of vegetative growth at the lower levels of Eps. A large saving in irrigation water was obtained at the lower levels of replacement of Eps. (Author's abstract)
W84-05066

SOIL CATION AND WATER DISTRIBUTION AS AFFECTED BY NH4NO3 APPLIED THROUGH A DRIP IRRIGATION SYSTEM,
Agricultural Research Service, Byron, GA. Southeastern Fruit and Tree Nut Research Lab.
J. H. Edwards, R. R. Bruce, B. D. Horton, J. L. Chesness, and E. J. Wehunt.
Journal of the American Society of Horticultural Science, Vol. 107, No. 6, p 1142-1148, 1982. 6 Fig, 6 Tab, 19 Ref.

Descriptors: *Peaches, *Drip irrigation, *Crop yield, *Fertilizers, *Aluminum, Ammonium nitrate, Plant growth, Soil chemistry, Hydrogen ion concentration, Calcium, Magnesium.

Drip irrigation has significantly increased both tree growth and marketable fruit yield where rainfall is lacking at critical times during the production cycle, as frequently occurs in the southeastern U.S. Drip irrigation can also be used to supply water-soluble nutrients, but this practice may have an effect on growth and fruit yield. 'Redglobe' peaches were grown under drip irrigation to compare applications of NH4NO3 through the irrigation system with broadcast applications. Soil pH, where NH4NO3 was applied through the irrigation system, decreased in the top 30 cm from 6.2 to 3.7 pH in the zone wetted by emitters that had been in place for 2 years, and from 6.2 to 4.5 pH in the zone where emitters had been in place for 6 months. Aluminum concentration in wetted zones increased from 0.01 to 1.45 meq/100 g of soil after 2 years and from 0.02 to 0.73 meq/100 g of soil after 6 months of NH4NO3 application through drip irrigation. Soil Ca and Mg concentrations were reduced in both wetted zones, but the greatest decrease occurred in the 2-year emitter site. The application of acid forming NH4NO3 fertilizer to a relatively small soil volume decreased pH and increased Al-solubility. These soil chemical characteristics reduce root density at the emitter and restrict the absorption of water, which had a large adverse effect on fruit yields. (Moore-IVI)
W84-05067

EFFECTS OF IRRIGATION PRACTICES ON VINE GROWTH, YIELD, AND QUALITY OF MUSKMELONS,
Arizona Univ., Tucson. Dept. of Plant Sciences.
W. D. Pew, and B. R. Gardner.
Journal of the American Society of Horticultural Science, Vol. 108, No. 1, p 134-137, 1983. 6 Tab, 8 Ref.

Descriptors: *Irrigation practices, *Plant growth, *Muskmelons, *Crop yield, Fruit crops, Irrigation, Soil water.

Irrigation experiments were conducted over 4 seasons in cooperation with a commercial muskmelon grower. In each year of the study wet treatments resulted in lower yields and smaller fruit. Plants receiving a prethinning irrigation were visibly smaller. The appearance of small tops on the plants in the prethinning irrigation treatment plots at thinning, coupled with the unnatural appearance of the root system from the mature plants, indicated a restricted, atypical plant- and root-growth pattern. This could have resulted from low oxygen levels. More fruits were culled due to decay where more irrigations were used. Decay was related to wetness of the tissue in contact with the soil. Some significant effects of treatment were found associated with vein tracts, flesh color, flesh firmness, and ratio of flesh to cavity, but these were not consistent from year to year. (Baker-IVI)
W84-05069

CONSUMPTIVE WATER USE OF IRRIGATED PECANS,
Texas A and M Research and Extension Center, El Paso.
S. Miyamoto.
Journal of the American Society of Horticultural Science, Vol. 108, No. 5, p 676-681, 1983. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Consumptive use, *Crop yield, *Pecans, *Irrigation requirements, Trees, Water demand, Water stress, Irrigation practices.

Water use data obtained from 7 commercial pecan orchards in the El Paso-Las Cruces valleys is presented. Such data are needed for planning and scheduling irrigation. Test trees (8 to 35 yr old) were surface-irrigated. The trees were of various size trunks (13-35 cm in trunk diameter) and planting densities (60-120 trees/ha). A neutron moisture probe was used to evaluate soil water depletion. Soil water depletion below a depth of 100 cm was minimal and independent of the horizontal distance from tree trunks except in young trees. Consumptive water use was highly dependent on tree size and planting density. Close-spaced, full-grown trees used 100 to 130 cm per season. An empirical equation was developed, based on these field data, for computing crop coefficients and consumptive use from trunk diameters, planting densities, and weather data. These equations are useful for estimating consumptive use of orchards with different tree sizes and populations. Estimates can be improved if a practical means of measuring live-leaf areas of trees becomes available. (Baker-IVI)
W84-05071

UTILIZATION OF RECYCLED IRRIGATION WATER ON MARIGOLDS FERTILIZED WITH OSMOCOTE AND CONSTANT LIQUID FERTILIZATION,
California State Univ., Fresno.
G. M. Koch, and E. J. Holcomb.
Journal of the American Society of Horticultural Science, Vol. 108, No. 5, p 815-819, 1983. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Irrigation practices, *Water reuse, *Fertilizers, Plant growth, Marigolds, Nitrogen, Phosphorus, Potassium, Trickle tube irrigation, Capillary mat irrigation, Water conservation.

In order to evaluate the use of leachate from Osmocote controlled-release fertilizer (CRF) and constant liquid fertilizer (CLF)as a partial source of irrigation water for greenhouse plants, marigolds were grown with either trickle tube or capillary mat irrigation. Within each fertilizer regime, half of the pots were irrigated and the leachate collected daily for reuse, while the other half pots were irrigated and the leachate discarded. Nitrate and potassium ions did not accumulate significantly in the irrigation reservoir when the leachate from Osmocote or CLF was used. No accumulation of salts occurred whether marigolds were irrigated by capillary mat or trickle tube. With one exception, plants fertilized with Osmocote at the recommended rate or twice this rate produced plants equal to or better than CLF at 100 ppm N. Except for recycled CLF, macronutrient content of plant tissues was within acceptable ranges. Fertilizer treatments did not affect the number of days to flower. The combination of Osmocote fertilization and capillary mat irrigation was more effective in producing high-quality plants than Osmocote fertilization and trickle-tube irrigation. Tap-water utilization was reduced substantially by using recycled water. (Baker-IVI)
W84-05072

YIELD COMPONENTS AND POD QUALITY OF SNAP BEANS GROWN UNDER DIFFERENTIAL IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Horticulture.
A. R. Bonanno, and H. J. Mack.
Journal of the American of Society of Horticultural Science, Vol. 108, No. 5, p 832-836, 1983. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Beans, *Irrigation effects, *Crop yield, Soil water potential, Water stress.

Field experiments were conducted to evaluate the effects of differential irrigation treatments on the yield and pod quality of 'Oregon 1604' and 'Galamor' snap beans (Phaseolus vulgaris L.) in 1981 and 1982. Treatments in which various levels of positive canopy minus air temperature differences (stress-degree-days (SDD)) accumulated between irrigations were evaluated along with irrigation at 4 growth stages, a dry treatment which received only one irrigation to establish plants, and a control treatment irrigated at -0.06 MPa soil water potential (SWP). In both seasons, yield was related

strongly to the average soil water potential from planting to harvest. Yields in 1982 were at least 5 MT/ha greater at a given average soil water potential than in 1981. Yields of 'Oregon 1604' and 'Galamor' were similar under adequate irrigation, but under greatest water stress, yield of 'Oregon 1604' was higher than for 'Galamor'. Pod number was reduced only in the dry treatment. Percentage of set pods, pod length, and number of seeds per pod were all reduced by low irrigation, while fiber content of pods and weight per seed were increased by low irrigation. (Author's abstract)
W84-05073

WATER RELATIONS AND GROWTH OF SNAP BEANS AS INFLUENCED BY DIFFERENTIAL IRRIGATION,
Oregon State Univ., Corvallis. Dept. of Horticulture.
A. R. Bonanno, and H. J. Mack.
Journal of the American Society of Horticultural Science, Vol. 108, No. 5, p 837-844, 1983. 10 Fig, 5 Tab, 31 Ref.

Descriptors: *Beans, *Irrigation effects, *Plant growth, *Water potential, Soil water, Water stress, Turgor, Transpiration, Evaporation, Stomatal closure.

Two field experiments were conducted to evaluate the effects of differential irrigation on plant growth, development, and water status of 2 snap bean cultivars, 'Oregon 1604' and 'Galamor' (Phaseolus vulgaris L.). Plants were grown at various irrigation levels ranging from a well-watered control to a dry treatment which received only one irrigation to establish plants. Measurements on plants sampled weekly at 6 times during the growing season showed that total plant dry weight, total leaf dry weight, total leaf area, average area per leaf, and number of leaves per plant were reduced by water deficits in both cultivars. Also, for both cultivars, total leaf area per plant was reduced more by a decrease in area per leaf than by a reduction in leaf number. Specific dry leaf weight was higher in the drier treatments. During each year, a significant difference between treatments occurred earlier in the season for total leaf area per plant than for total plant weight. At predawn, leaf water potential (Psi) always was more negative in the dry treatment than in the control. Early in the season, there was no significant difference in midday Psi between the control and dry treatment. Later, as soil water became limiting, the dry treatment had a more negative Psi than the control. Near the end of the season, after the dry treatment had been subjected to a long period of water stress, midday Psi was more negative in the control than in the dry treatment. Although some osmotic adjustment occurred in the dry treatment, leaf turgor potential (Psi p) was generally lower than in the control throughout the day. As Psi decreased from early morning through midday, transpiration rates increased due to an increase in evaporative demand on the leaves. Leaf diffusive resistance also increased with decreasing Psi but a 'threshold value' for stomatal closure was not demonstrated. (Author's abstract)
W84-05074

WATER USE AND CONSERVATION IN THE SOVIET UNION (JOKIEN MONINAISKAYTOSTA JA SUOJELUSTA NEUVOSTOLIITOSSA),
Turku Univ. (Finland). Institutum Geographicum.
H. Mansikkaniemi.
Terra, Vol. 95, No. 4, p 227-231, 1983. 2 Fig.

Descriptors: *USSR, *Water conservation, *Drainage, Planning, Irrigation, Water pollution control.

The activities of the water planning boards in the Soviet Union are extremely extensive. There are two million people employed in these operations and of these 70000 are engaged in actual planning work. Their tasks include designing irrigation systems in dry areas and also drainage systems in wet regions. The present aim is to drain 1 million hectares per year and also irrigate a corresponding area. The Soviet authorities have noted that pollution of many rivers has risen to a worrying level. To prevent the situation deteriorating further a start had recently been made a large-scale program of care and protection embracing all those rivers where the main channel is more than 200 km long or the precipitation area is more than 2000 sq km. (Author's abstract)
W84-05081

DRIP IRRIGATION OF COTTON WITH TREATED MUNICIPAL EFFLUENTS: I. YIELD RESPONSE,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5D.
W84-05115

DRIP IRRIGATION OF COTTON WITH TREATED MUNICIPAL EFFLUENTS: II. NUTRIENT AVAILABILITY IN SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
For primary bibliographic entry see Field 5D.
W84-05116

IMPACT OF WATER CUTBACK ON SUGARCANE PRODUCTION IN THE FLORIDA EVERGLADES,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Water Resources Bulletin, Vol. 20, No. 2, p 187-191, April, 1984. 5 Tab, 10 Ref.

Descriptors: *Sugarcane, *Everglades, *Florida, *Water cutback, Water conservation, Water table, Drought, Crop yield, Water demand.

Sugarcane (Saccharum spp.) was planted in six lysimeters containing Pahokee muck (Lithic Medisaprist) where water tables were maintained at 30, 60, and 90 cm depths. The main objective was to study the impact of a 40% water cutback (108 mm) on sugarcane production during the period near the end of the dry season (i.e., May). The water cutback treatment was simulated through manipulation of water table depth. Due to the high available water capacity of the muck soil and selection of a sugarcane cultivar 'CP63-588' (which has a high tolerance of water table fluctuations), the sugarcane growth, and the yields of sugarcane biomass and sugar were not significantly different as a result of the treatments with and without 40% water cutback during a period of two months. This result is in good agreement with the 1981 cane yield in the Everglades Agricultural Area where a 35% water cutback was imposed during the 1981 drought. (Author's abstract)
W84-05157

GEOSTATISTICAL APPROACH TO THE TRICKLE IRRIGATION DESIGN IN A HETEROGENEOUS SOIL. 2. A FIELD TEST,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
D. Russo.
Water Resources Research, Vol. 20, No. 5, p 543-552, May, 1984. 8 Fig, 4 Tab, 13 Ref.

Descriptors: *Trickle irrigation, *Crop yield, Irrigation practices, Irrigation, Water supply development, Soil properties.

The spatial variability of the measured midway soil water pressure head as well as the total fruit yield of bell pepper obtained under uniform and nonuniform spacing between trickle irrigation emitters throughout the field are analyzed. In a heterogeneous field in which the soil water properties vary under a deterministic uniform trickle irrigation system, the midway soil-water pressure head (h-c), and the yield of a crop also differ from place to place. The experimental plan was tested to determine whether the spatial variability of the response of a heterogeneous field could be reduced by using a spatially variable trickle irrigation system. The reduction in the spatial variability of the field response was expected to reduce the spatial variability in the crop yield Y, which in turn may increase the average over the field crop yield. Twenty-five plots were established on a 30 sq m grid. Half of each plot was equipped with a standard trickle irrigation system with constant spacing between emitters of d = 50 cm. The other half was equipped with a trickle irrigation system for which the spacing between the emitters was selected by using the pertinent hydraulic properties according to the procedure of Bresler (Irrigation Science, Vol. 3, p 3-17, 1978). Use of a spatially variable d relative to the use of a uniform d did not change the seasonal behavior of h-c, but reduced the spatial variability, increased the integral scale, but increased the average fruit yield by only 1.9%. When emitters were properly spaced it was not the water but other factors that most influenced yield. (Baker-IVI)
W84-05328

ECONOMIC RESULTS OF SIMULATED CHANGES IN PAKISTAN'S IRRIGATION SYSTEM,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
S. H. Johnson, III, and J. O. Reuss.
Water Resources Research, Vol. 20, No. 5, p 629-632, May, 1984. 1 Fig, 6 Tab, 14 Ref.

Descriptors: *Water resources development, *Irrigation practices, *Water management, Pakistan, Model studies, Punjab, Crop yield, Indus River Basin.

An integrative simulation model is used to simulate alternative water management systems for the Punjab, the largest state in Pakistan. Results from the model indicate that current canal closure schedules severely restrict economic returns from possible cropping systems. Closure during February, or in April after wheat harvest, increases possible returns by $20-$30 per hectare. Demand systems, while strongly advocated by numerous consultants, are not as economically productive as are present continuous flow systems. Only after per hectare water allocation is increased by more than 1.5 times do demand systems provide a higher per hectare economic return. A more viable alternative is continued use of the present system, supplemented by private tube wells operated on a demand basis. As more than 150,000 of these are already installed and in operation in the Punjab, capital investment is shifted from the public to the private sector. Initial results from the simulation model using base constant flow plus 5 ha cm per week of demand flow from private tube wells indicate that economic returns per hectare are greater than for the same quantity of water provided by constant flow or demand flow alone. Application efficiency is higher than constant flow and only marginally less than for a pure demand system. With more than 8 million ha of irrigated land in the Punjab, losses from canal closure during December could exceed $200 million per year. (Baker-IVI)
W84-05335

WATER-MANAGEMENT POTENTIAL OF RUNOFF-CONTROLLED IRRIGATION AND SOME BASIC SUGGESTIONS FOR IMPLEMENTING THE PROCEDURE (WASSERWIRTSCHAFTLICHE POTENZEN DER ABFLUSSGESTEUERTEN BEWASSERUNG UND EINIGE GRUNDAUFGABEN ZUR EINFUHRUNG DES VERFAHRENS),
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
R. Meissner.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 167-171, May, 1983. 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Water management, *Irrigation efficiency, *Irrigation, Irrigation-return flow, Irrigation programs, Irrigation practices, Irrigation water, Water demand.

An alternative to conventional methods of covering the water demand for overhead irrigation during periods of low availability is runoff-controlled irrigation (RCI), the main goal of which is to shift irrigation times into periods in which there

is no water shortage. In this way the storage capacity of the ground is utilized, and irrigation-water demand is reduced by 25% for a mean application of 100 mm during the critical July-October period. Experiments in the procedure were performed at three locations in the German Democratic Republic between 1973 and 1980. For location Lo1, RCI (irrigation only when adequate runoff as measured by lysimeter were available) resulted in the application of 60 mm less water during hydrological shortage periods than irrigation controlled by climatic water balance (CWI) and 47 mm less than irrigation controlled by a combination of runoff supply and crop need (RNI). Mean crop yield was almost identical for all three irrigation variants. During hydrological shortage periods at location D2, RCI used 86 mm less water than irrigation according to government guidelines (GI) and 72 mm less than RNI. For the period 1974-1980 at D2, RCI, GI and CWI, and RNI resulted in absolute crop-yield increases of 32, 38 and 48%, respectively. At location V1 in 1980, RCI according to measurements at a specific lysimeter, RCI with water reduction during shortages, and GI were compared. Under mostly normal hydrological conditions, similar crop yields were produced and almost the same amounts of irrigation water were needed. An economic analysis of results at D2 showed that profit made from higher crop yields made possible by the greater amount of sprinkling allowed by GI were not enough to offset higher production and water-storage costs, the latter of which were absent for RCI. It is planned to incorporate the principles of RCI into GI, and a concept for this is described using a computer to provide feedback information to farmers via the local water management district. (Gish-IVI)
W85-04800

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EFFECT OF CUTTING ON THE GROWTH AND RECESSION OF THE FRESHWATER MACROPHYTE RANUNCULUS PENICILLATUS (DUMORT.) BAB. VAR. CALCAREUS (R. W. BUTCHER), C. D. K. COOK,
Reading Univ. (England). Dept. of Zoology.
S. F. Ham, J. F. Wright, and A. D. Berrie.
Journal of Environmental Management, Vol. 15, No. 3, p 263-271, October, 1982. 1 Fig, 3 Tab, 9 Ref.

Descriptors: *Cutting management, *Growth, *Growth rates, *Macrophytes, *Ranunculus, Rivers, Flood prevention, Fishery management, River Kennet, Littlecote, River Lambourn, Bagnor.

Aquatic macrophytes grow profusely in English chalk streams, where they usually have high levels of nutrients and a stable flow regime. During the summer, the growth can seriously impede the flow of water and cause flooding of neighboring land. Two sites, one on the River Kennet at Littlecote and the other on the River Lambourn at Bagnor, were used to examine the effect of bar cutting on the growth and recession of the dominant macrophyte, Ranunculus penicillatus var. calcareus. At the Littlecote site, uncut Ranunculus was flowering by mid-May and started to wash out in July. Plants cut on 30 April flowered by early June, but did not begin to wash out until September. Ranunculus cut on 5 June regrew, but was unable to flower, and produced large areas of vegetative growth which led to increased cover in the following winter. Cutting in September was effective in controlling cover of Ranunculus during the winter, but was only applied to areas where Ranunculus was being washed out naturally. At the Bagnor site, cutting on 30 May delayed the time of wash out of Ranunculus, but did not increase its cover during the winter. It was concluded that, if Ranunculus was left uncut, it would begin to wash out naturally soon after flowering. A cut before flowering did not control growth and could increase the amount of Ranunculus during the following winter. Cutting at the time of flowering was the most effective way to control the summer growth. (Murphy-IVI)
W84-04818

THEORETICAL PROPERTIES OF THE OPTIMAL RELEASE FOR A MULTI-PURPOSE RESERVOIR WITH CORRELATED INFLOWS,
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
L. V. Tavares.
Journal of Hydrology, Vol. 58, No. 3/4, p 237-250, September, 1982. 26 Ref.

Descriptors: *Multipurpose reservoirs, *Model studies, Stochastic process, Reservoirs, Stochastic hydrology, Dynamic programming, Systems analysis.

A general model is proposed to study a multipurpose reservoir with auto-correlated inflows and a stochastic dynamic programming formulation is used to derive three theorems concerning the reduction of the dimension of the state space, the concavity of the objective function, and the functional form of the optimal releases policy with a time varying utility function. The model assumes significant persistence for the inflow time-series as well as a time-varying utility function. The stochastic dynamic programming formulation is used not to compute numerical solutions but rather to deduce the following analytical conclusions: the usual description of the state of the system by a two-component vector can be synthesized by a scalar without any loss of information; the functional form of the optimal releases policy is deduced assuming that the generated marginal utility does not depend on the release obtaining a generalization of the linear decision rule. For this last case, the computational work required to determine the optimal solution can be greatly reduced by making use of the previous conclusions because the optimal parameter to be determined at each stage only depends on the state of the system through the expectation of the inflow during next time unit. It is proved that if the marginal generated utility depends on the release, then its optimal value is a non-linear function of the existing storage and hence neither the linear decision rule nor the delta-rule is the best operations policy. An algorithm is proposed to determine the optimal releases making use of the various conclusions reached. (Baker-IVI)
W84-04849

ECONOMIC FEASIBILITY OF FLOOD CONTROL IMᵖROVEMENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W84-04954

OPTIMAL OPERATION OF MULTIPLE RESERVOIR SYSTEMS,
Texas Dept. of Water Resources, Austin. Engineering and Environmental Systems Section.
Q. W. Martin.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 58-74, January, 1983. 3 Fig, 25 Ref.

Descriptors: *Reservoirs, *Operating policies, Management, Water resources development, Powerplants, Planning, Decision making.

A computational procedure has been developed to solve the problem of obtaining the most beneficial long-term operation of a surface water resources system so as to meet the purposes of water supply, stream flow maintenance, and hydroelectric power generation, while satisfying operational constraints for the system. The procedure is based upon the representation of the steady-state operation of a general surface water system of reservoirs, stream junctions, natural waterways, pipelines, and canals as a network flow problem. The incorporation of hydroelectric power generation benefits are undertaken by solving successive minimum cost network flow problems, where flow bounds and unit costs are modified between successive iterations to reflect first-order changes in hydroelectric power generation with flow release rates and reservoir storage. The procedure is shown to converge to a stationary or local optimum solution. Convergence to the global optimum could not be guaranteed since the benefit function is not convex. The algorithm, as coded in the AL-V and SIM-V programs, was applied to a large scale system of 27 reservoirs on the Arkansas, White, and Red Rivers. The derived system operating policy computed a potential increase of about 8% in the firm power production of the system over that determined in a previous study. (Baker-IVI)
W84-04956

INTEGRATED DEVELOPMENT OF A LARGE RIVER: THE RHONE; A. GENERAL DESIGN AND EFFECT ON FLOODS AND SUBSURFACE WATER LAYERS (L'AMENAGEMENT INTEGRE D'UN GRAND FLEUVE: LE RHONE; A. CONCEPTION GENERALE ET EFFETS SUR LES CRUES ET LES NAPPES PHREATIQUES),
Compagnie Nationale du Rhone, Lyon (France).
For primary bibliographic entry see Field 8A.
W84-05019

WATER USE AND CONSERVATION IN THE SOVIET UNION (JOKIEN MONINAISKAYTOSTA JA SUOJELUSTA NEUVOSTOLIITOSSA),
Turku Univ. (Finland). Institutum Geographicum.
For primary bibliographic entry see Field 3F.
W84-05081

HADDINGTON FLOOD WARNING SCHEME,
Forth River Purification Board, Edinburgh (Scotland).
R. J. Sargent.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 2, p 108-118, April, 1984. 5 Fig.

Descriptors: *Flood forecasting, *Automation, *Haddington, *Scotland, Microprocessors, Computers, Data acquisition, Decision making, Catchment areas, Flood warning.

The flood problem at Haddington in the Tyne catchment is used to provide an example of the use of automatic data collection and control. The flood water is generated on the steep slopes of the Lammermuir Hills, which lie to the south of the town and are drained by two main tributaries, the Birn's Water to the west and the Gifford to the east. Microprocessor technology provides a flood warning system where 24 hr manning would not otherwise be possible. The microprocessor automates both the collection of field data and the consequent operational decision-making. Remote stations are regularly interrogated by radio and quality control operations are then performed on the data received. While some faults were expected, the equipment has functioned nearly faultlessly with the few failures being the result of radio links. Cost details of the scheme are provided. (Baker-IVI)
W84-05136

MUNICIPALITIES ACT TO SUPPLEMENT DWINDLING GROUNDWATER SUPPLIES,
For primary bibliographic entry see Field 5F.
W84-05150

DEVELOPMENT OF THE WESTERN TIGRIS-BASIN IN TURKEY (AUSBAU DES WESTLICHEN TIGRIS-BECKENS IN DER TURKEI),
9 Eylul Univ., Izmir (Turkey). Dept. of Engineering and Architecture.
U. Ozis.
Wasserwirtschaft, Vol. 73, No. 4, p 109-112, April, 1983. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Tigris basin, *Turkey, *Water resources development, *Water harvesting, Regional

development, Hydroelectric power, Irrigation programs.

In the western Tigris basin Turkey is developing projects to irrigate 0.6 million hectares and to generate 8 billion KWh/a electricity with 2200 MW installed capacity, at a cost of 15 billion DM. The project includes 4 dams on the main stream, with several installations on branches of the river. The comprehensive project consists of several inherent projects which include the Kralkizi-Dicle, Silvan, Batman, Garzan, Ilisu and the Cizre projects, approximately 18 in all. The majority of the projects will occur upstream while a few major projects are in the lower Tigris. (Murphy-IVI)
W84-05237

TINAJONES PROJECT PART II (DAS TINAJONES-PROJEKT TEIL II),
Salzgitter A.G. (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W84-05254

4B. Groundwater Management

GROUNDWATER STATE OF THE ART: IS IT ADEQUATE,
G. Goldstein.
Civil Engineering, Vol. 54, No. 4, p 68-72, April, 1984. 5 Fig.

Descriptors: *Groundwater management, *Water pollution control, Education, Training, Path of pollutants, Prevention, Legislation, Monitoring, Model studies.

Graduate level training must be increased in the area of groundwater management. The focus of groundwater education must take into account the rapid changes taking place in the field. Many complex problems which in earlier years would have been handled by a civil engineer or geologist now require the special knowledge of hydrogeologists and specialists in mathematical modeling, organic chemistry, geophysics, and microbiology. More research is needed on transport of contaminants in fractured rock and fractured silt and clay, the migration of toxic liquids that sink because of their high density, chemical and biochemical reactions of organic compounds in groundwater, epidemiology, contaminant migration and flow systems, and models. Preventive measures which should be taken to protect groundwater from future pollutants are listed. (Baker-IVI)
W84-04924

INVESTIGATIONS FOR ARTIFICIAL RECHARGE OF THE TRIASSIC SANDSTONES AQUIFER NEAR STOURBRIDGE, UK,
Severn-Trent Water Authority (England).
H. H. Jones.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 1, p 9-27, February, 1983. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Stourbridge, *England, Water resources development, Reservoirs, Aquifers, Water resources development, Conjunctive use.

The demand for water resources in the Midlands of England is expected to increase, but at a lower rate than previously anticipated. The science and engineering of borehold recharge is discussed along with the current standards which are being adopted for the proposed recharge plant at Stourbridge in the West Midlands. The conventional method of obtaining public supplies from the Triassic Sandstones is to pump water directly from boreholes into service reservoirs. The construction of new boreholes will be limited to areas where there is adequate natural recharge, where pollutants such as nitrates and chlorides are unlikely to exceed standards for water supplies, and where the boreholes are sufficiently close to the location of demands for the total cost, including pipelines, to remain economic. Conjunctive use and artificial recharge using boreholes may enhance resources in the Midlands. Observation boreholes have now been constructed at twelve sites to monitor conditions in the aquifer. At five sites the boreholes are either constructed to different levels or are equipped with nested piezometers to measure vertical variations of groundwater level and quality. The purpose of these boreholes is to provide an adequate understanding of the hydrogeology and geochemistry of the area, to calibrate a mathematical model of the aquifer that will be used to predict the effects of recharge and abstraction, and to monitor groundwater levels and quality. (Baker-IVI)
W84-05049

ISOTOPICAL DIFFERENTIATION OF GROUNDWATER OF DIFFERENT HYDROGEOLOGIC ORIGIN,
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
M. A. Geyh, and G. Michel.
Journal of Hydrology, Vol. 59, No. 2, p 161-171, October, 1982. 6 Fig, 1 Tab, 9 Ref.

Descriptors: *Water supply development, *Groundwater management, *Tritium, *Weser River Valley, *West Germany, Limestone, Aquifer recharge, Isotope studies, Geohydrology, Leaching.

In connection with the construction of a new pumping station for public water supply in the Weser River valley at Hoxter, Germany, it was necessary to determine the origin of the groundwater to be exploited. Tritium concentrations in groundwater samples collected from various production and observation wells in the area during the summer of 1980 ranged from 15 to 70 TU. Both the isotopic and hydrochemical data favor the hydrogeological model in which the groundwater in the solution basin of the Weser Valley at Hoxter originates mainly from the Muschelkalk Formation. The hydrogeologic survey of this area yielded an improved geologic profile which clearly shows a hydraulic connection between the porous aquifer in the solution basin and the limestone of the Muschelkalk. In contrast to the previous geological concept, it is now assumed that the solution basin was formed by leaching of saline rock of the Rot Formation (upper Buntsandstein) instead of rock of the Zechstein Formation. (Baker-IVI)
W84-05133

MEETING PEAK DEMAND IN DRINKING WATER SUPPLY BY GROUND WATER RESERVOIRS (SPITZEN - BEREITSTELLUNG IN DER TRINKWASSERVERSORGUNG MIT HILFE VON GRUNDWASSERSPEICHERN),
Energie-und Wasserversorgung A.G., Nuerenberg (Germany, F.R.).
C. Pob.
Wasserwirtschaft, Vol. 73, No. 6, p 169-175, June, 1983. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Peak demand, *Drinking water supply, *Groundwater reservoirs, Groundwater availability, Groundwater potential, Conjunctive use, Water deficit, Water supply development, Water supply.

Many water facilities must accommodate peak demand schedules. In so doing elaborate storage systems incurring expenses are utilized. The use of small accessable groundwater reservoirs for supplementing the peak demand is discussed. Using the nearby groundwater reservoirs, costs for drinking water supply may be lowered. Required reservoir capacity and advantages and disadvantages of ground water reservoirs are discussed. Drainable pore water in natural uncohesive granular soils for unconfined water table are analyzed for groundwater reservoir tapping efficiency. The planned utilization of a natural groundwater reservoir with considerations on a system of wells to meet peak demand are discussed. (Murphy-IVI)
W84-05242

INTEGRATION OF SURFACE WATER WITH GROUNDWATER RESOURCES AIDED BY NUMERICAL MODELLING,
Pavia Univ. (Italy). Inst. of Hydraulics.
M. Fugazza, M. Gallati, U. Moisello, and L. Natale.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 155-168, 1983. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Confined aquifers, *Groundwater management, *Philippines, Water resources development, Finite element analysis, Model studies, Numerical models, Irrigation, Water demand, Water supply development, Planning, Water management.

The possibility of a gradual extension of the irrigable area of the Tarlac Irrigation System was studied. The system is located in the alluvial plain of Luzon Island in the Philippines. The extension would be made by integrating groundwater with surface water supplied from a reservoir. Aquifer exploitation was studied, adopting the criterion that groundwater is a very expensive resource to be turned to only in severe drought years. The objectives of the study were to plan the distribution of the wells so as to minimize the pumping cost and to establish a policy for the well management in conjunction with the reservoir operation. Different schemes of the combined system management were analyzed on the basis of the climatic and hydrological regime over the period 1950-1972. For this period the monthly water requirements of different crops and monthly values of aquifer recharge were computed. The economic analyses were performed using present prices of agricultural products and power together with several different hypotheses about future prices. A finite element model of the semiconfined aquifer was postulated and calibrated. The importance of the return flow from irrigation was also tested. Simulations of exploitation schemes provided a detailed forecast of the aquifer response to the irrigation demands. (Baker-IVI)
W84-05303

OPTIMIZATION OF GROUNDWATER ABSTRACTION FROM A COASTAL AQUIFER,
Institute of Hydrology, Wallingford (England).
E. H. Morel, and A. B. Birtles.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 169-182, 1983. 7 Fig, 8 Tab.

Descriptors: *Mathematical models, *Groundwater management, *Coastal aquifer, Aquifers, Jacobian elliptic function, Pumping, Unconfined aquifers, Saline water intrusion, Drawdown.

An analytical mathematical model, based on Jacobian elliptic functions, has been used to identify feasible wellfield locations and pumping rates for large scale abstraction from an unconfined coastal aquifer. The requirement to provide water of an acceptable quality implies a need to limit the extent of saline intrusion at the coast, and to limit drawdowns in the vicinity of the river. Permissible wellfield locations are restricted to bands which run parallel to the coast. Results indicate that the cheapest wellfield design would be a single large wellfield. However, because of the need to provide at least a minimum supply to the city until a new supply can be installed, a better solution may well be for two wellfields supplying a total of 66% of the recharge even though this would be more expensive. These wellfields would be located closer to the coast. The optimum wellfield location has been found to be relatively insensitive to the actual amount of the annual average recharge to the aquifer. (Baker-IVI)
W84-05304

METHOD OF CALCULATING THE CONCENTRATION OF DEPOSIT AROUND AN INJECTION WELL,
Krakow Technical Univ. (Poland). Faculty of Sanitary and Environmental Engineering.
W. Dabrowski.
Water Research, Vol. 18, No. 6, p 709-717, 1984. 9 Fig, 10 Ref.

Descriptors: *Filtration, *Model studies, Mathematical equations, Balance equation, Injection wells, Permeability, Screens, Aquifer recharge.

In modeling deep radical filtration, the balance equation in a simplified form is usually taken into account. This simplification causes an error in modeling. A simple method of calculating the value of this error is presented. An inequality is derived from the equations analogous to the Herzig-Leclerc-Le Goff equations. This inequality can be used for calculating the concentration of deposit around an injection well. The full balance equation for solid particles and the kinetic equation in the general form are taken into consideration. The maximum relative error of the method is calculated. The deep radical filtration through the uniform and non-uniform porous media is considered. (Baker-IVI)
W84-05317

STABLE-ISOTOPE GEOHYDROLOGY OF THE LOWER MANER BASIN, ANDHRA PRADESH, INDIA,
National Geophysical Research Inst., Hyderabad (India).
B. Kumar, R. N. Athavale, and K. S. N. Sahay.
Journal of Hydrology, Vol. 59, No. 3-4, p 315-330, November, 1982. 7 Fig, 3 Tab, 12 Ref.

Descriptors: *Groundwater management, *Isotope studies, Water resources development, Semi-arid regions, Lower Maner Basin, Andhra Pradesh, India, Maner River, Irrigation, Precipitation.

Hydrogen (D/H) and oxygen (18/16) isotopic ratios were measured in precipitation-, lake-, stream- and well-water samples collected from the Lower Maner Basin, Andhra Pradesh, India during 1976-77. Granites, sandstones, quartzites and shales comprise the main lithological units exposed in the basin, which has a semi-arid climate and an average annual rainfall of 1000 mm. The basin is characterized by lakes and tanks of varying capacities. The meteoric water line for the Basin is similar to the global meteoric water line. Discharge in the Maruvancha Stream, which is the only perennial tributary to the Maner River, consists largely of return flow of irrigation water. The relative contribution of surface and groundwater to the discharge during a low-flow month was approximately 80% and 20%, respectively. Isotopic ratios of well waters show different degrees of enrichment vis-a-vis the weighted mean isotopic ratios for pecipitation waters. The post- and pre-monsoon samples collected from the same wells, having a time gap of about 6 months, have generally identical isotopic ratio values, indicating there is no substantial loss of groundwater due to evaporation from the zone of saturation. Isotopic ratios of most of the well samples indicate percolation of precipitation as the main source of recharge. The groundwater of the basin can be classified into two isotopical types, consistent with lithology and degree of compactness of the formations. (Baker-IVI)
W84-05344

4C. Effects On Water Of Man's Non-Water Activities

TIMBER HARVESTING AND FLOODING,
Plum Creek Timber Co., Inc., Missoula, MT.
S. Hess.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 115-117, March-April, 1984. 3 Fig, 9 Ref.

Descriptors: *Flood control, *Forest management, *Channel erosion, Clear-cutting, Logging, Cutting management, Erosion control, Erosion, Storms, Snow, Rainfall, Watersheds, Cabin Creek Watershed, Washington.

An evaluation was undertaken of flooding in the Cabin Creek watershed, which lies on the east slope of the Cascade Mountains near Easton, Washington. This drainage has been managed intensively for timber production over the past 25 years, during which time flooding has been a recurring problem. Cabin Creek enters the Yakima River near the community of Easton. Severe channel erosion occurred in December 1975 and 1977 as a result of extremely high flows produced by major rain-on-snow storms. Research has consistently demonstrated that wet-mantle flood peaks are not significantly affected by the presence or absence of vegetation. Management activities in the Cabin Creek watershed have been fairly consistent since timber management began in 1958. There was no apparent relationship between channel erosion and the percentage of upstream timber that had been removed. Debris torrents from tributary streams in the Cabin Creek watershed could all be traced to mass failures on adajcent slopes. These mass failures came from roads, clearcuts, and undisturbed areas. Mobile organic debris accounted for much of the flood damage that occurred. These findings support the theory that channel erosion occurs primarily as the result of floods from major winter storms. (Baker-IVI)
W84-05056

4D. Watershed Protection

EFFECTS OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM CHEMISTRY,
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 5B.
W84-05114

SEDIMENTATION IN NADIS IN THE INDIAN ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Basic Resources Studies.
K. D. Sharma, and P. C. Chatterji.
Hydrological Sciences Journal, Vol. 27, No. 3, p 345-352, September, 1982. 5 Fig, 3 Tab, 4 Ref.

Descriptors: *Nadis, *India, *Sedimentation, *Water supply, Sediment yield, Arid zone, Watershed management, Vegetation, Silt traps, Ponds.

The people of the Indian Arid Zone harness the meager precipitation in small earthen dugout/embankment ponds called Nadis. This is an ancient practice and the Nadis are the most important resources of the region; water from them is consumed by humans and livestock. Water from Nadis is available for 2 to 12 months, depending upon the drainage basin characteristics, the amount of rainfall received, and its distribution. Nadis are subjected to heavy sedimentation due to erratic and torrential rainfall in sandy and eroded rocky basins. Sediment yield depends upon the physiography, lithology, basin characteristics and the rainfall intensity and amount. Coarse to medium grained, loose and less compact formations lose more sediments with the increasing rainfall and basin slope than the fine-grained, hard and compact formations. The sediment input can be reduced appreciably by allowing vegetation in the basins, and by constructing silt traps at the entrance of the Nadi. (Moore-IVI)
W84-05291

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINATION OF TRACES OF INORGANIC POLLUTANTS (CU, PB, CD, ZN) IN WATER, BY DIFFERENTIAL PULSE ANODIC STRIPING VOLTAMMETRY AT A ROTATING MERCURY FILM ELECTRODE (DOSAGE DE MICOPOLLUANTS MINERAUX DES EAUX, (CU, PB, CD, ZN), PAR VOLTAMPEROMETRIE DE REDISSOLUTION ANODIQUE IMPULSIONNELLE SUR ELECTRODE TOURNANTE A FILM DE MERCURE),
M. Bouzanne.
Analusis, Vol. 9, No. 10, p 461-467, December, 1981. 5 Fig, 11 Ref.

Descriptors: *Trace metals, *Copper, *Lead, *Cadmium, *Zinc, *Pulse anodic stripping voltammetry, *Rotating mercury film electrode, Measuring instruments, Performance evaluation.

Among advanced electrochemical methods, the various anodic stripping techniques seem likely to meet the combined requirements of sensitivity, accuracy, swiftness and simplicity necessary for the determination of trace inorganic pollutants in waters. The choice of the method, of some analytical devices (rotating mercury film electrode, rapid desoxygenation apparatus) and procedure has been made in view of fast determination and in situ monitoring. The deoxygenation method allows the treatment of a 10 ml sample in 80 s. Under the best conditions, some nanogram/liter of Cu, Pb, Cd, Zn can be detected after a 15 min. electrolysis. In the microgram/liter range, the simultaneous determination of 3 to 4 elements by known addition method is possible within 15 min. At this concentration level, the relative standard deviation for 8 successive measurements is about 1 to 2%. (Author's abstract)
W84-04809

MEASURING AND PREDICTING WATER QUALITY IN RECREATION RELATED TERMS,
Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6B.
W84-04820

POLYNUCLEAR AZAARENES IN WOOD PRESERVATIVE WASTEWATER,
Pittsburgh Univ., PA. Graduate School of Public Health.
J. Adams, and C.-S. Giam.
Environmental Science and Technology, Vol. 18, No. 5, p 391-394, May, 1984. 2 Fig, 2 Tab, 42 Ref.
National Science Foundation Projects OCE 80-19601 and OCE 77-12482.

Descriptors: *Pollutant identification, *Organic compounds, *Public health, *Wood preservatives, Hazardous materials, Wastewater treatment, Activated sludge processes, Polynuclear azaarenes, Azaarenes, Creosote, Preservatives, Quinoline, Isoquinoline, Benzoquinoline, Acridine.

Polynuclear azaarenes in a creosote-pentachlorophenol wood preservative wastewater were analyzed. The gas chromatogram of the basic fraction isolated from the creosote-PCP wood preservative wastewater indicated that there were numerous compounds present. By use of GC retention time and mass spectral analysis, polynuclear azaarenes such as quinoline, isoquinoline, and alkyl- and benzo-substituted azanaphthalenes were characterized at a total concentration of 1300 mg/kg. The presence of polynuclear azaarenes in this wastewater implies that an adverse effect on environmental quality can result from improper disposal of such wastes. Acknowledging the findings that quinoline and isoquinoline resist activated sludge treatment of wastewaters leads to the suggestion that the determination of polynuclear azaarenes be included in hazardous wastes analytical protocols. (Baker-IVI)
W84-04892

ANALYSIS AND CHARACTERIZATION OF NATURAL ORGANIC MATTERS IN FRESHWATERS; I. STUDY OF ANALYTICAL TECHNIQUES,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle, P. Deladoey, J. Zumstein, and W. Haerdi.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 325-362, 1982. 20 Fig, 7 Tab, 28 Ref.

Descriptors: *Water analysis, *Organic compounds, Fulvic acid, Natural waters, Lakes, Ponds, Thermogravimetry, Fluorescence, Ultrafiltration, Organic matter, Humic compounds.

Several analytical techniques have been studied for the analysis and characterization of humic and fulvic compounds of freshwaters. Forty-seven water samples, with various characteristics, were taken from marshes, ponds, rivers and lakes. Water extracts of soils and in vitro decomposition products of leaves were also studied for comparison.

Two methods were tested for the measurement of dissolved organic carbon. The factors which may influence the signal, in particular the injected volumes and the nature of organic compounds were also tested. The use of thermogravimetry was studied for the measurement of concentration and characterization of dissolved organic matter. This method was useful for the latter purpose, but it may be strongly influenced by the nature and concentration of inorganic ions. The role of the nature of samples, of pH and of iron content, on UV absorption of samples, was also studied. The freezing technique was investigated for preconcentration of organic matter. The effectiveness of the various techniques may be strongly affected by the concentration of fulvic compounds. Adsorption on freshly precipitated calcium carbonate could be one of the important processes of elimination of organic matter. (Baker-IVI)
W84-04916

INFLUENCE OF METAL COMPOUNDS ON FULVIC ACID/MOLYBDENIUM BLUE REACTIVE PHOSPHATE ASSOCIATIONS,
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
C. Steinberg, and G. F. Baltes.
Archiv fur Hydrobiologie, Vol. 100, No. 1, p 61-71, April, 1984. 4 Fig, 18 Ref.

Descriptors: *Phosphates, *Metals, *Fulvid acid, *Molybdenum blue, Natural waters, Organic compounds, Molecular weight, Ultraviolet radiation, Iron, Manganese, Peat bog.

In natural waters, a bimodal distribution of phosphates, which may be determined by common molybdenum blue methods without hydrolysis, can often be found by separating dissolved organic water constituents, mainly fulvic acids. The water tested in the present study was collected form the Latschensee, a raised peat bog. Fulvic and humic acids in this lake derived mainly from the decomposition of Spagnum mosses. Separation of fulvic acid/molybdenum blue reactive phosphorus (MRP) compounds from the peat bog water using gel permeation chromatography (Sephadex G-25) revealed a bimodal distribution pattern of phosphates: low molecular weight (lmwt) and high molecular weight (hmwt) MRP. Hmwt MRP seems to be sensitive to UV-radiation. The additions of iron ions (up to 1.5 mg/l Fe) and of manganese in low concentrations caused decreases of lmwt MRP and simultaneous increases of hmwt MRP by formation of colloids. Higher amount additions of manganese ions (up to 5.0 mg/l Mn), as well as each addition of cadmium ions, led to decreases of hmwt MRP and increases of lmwt MRP. The latter effect is most likely due to catalytic cleavage of hmwt MRP by the added metals. An electrostatic mechanism was probably not responsible for the release of phosphate in the test series, as alkaline conditions were not present. (Moore-IVI)
W84-05004

MERCURY POLLUTION IN THE WATERS AROUND HARBOORE TANGE AND LIMFJORD, DENMARK,
Marine Pollution Lab., Charlottenlund (Denmark).
H. U. Riisgard.
Marine Pollution Bulletin, Vol. 15, No. 4, p 129-133, April, 1984. 6 Fig, 12 Ref.

Descriptors: *Mercury, *Denmark, *Monitoring, *Coastal waters, Fjords, Mussels, Chemical industry, Waste dumps, Water pollution sources, Heavy metals, Bioindicators.

High concentrations of mercury have been measured in mussels (Mytilus edulis) collected in two 'hot spot' areas: (1) near a closed-down chemical factory on the west coast of the Limfjord, and (2) or groynes in the immediate vicinity of a chemical deposit in the dunes on the Danish west coast. By collecting comparable samples of mussels from chains of buoys, the mercury pollution in the western Limfjord could be traced 50-100 km into the central and innermost parts of the Limfjord as a gradual decreasing mercury concentration gradient. By collecting mussels from groynes north and south of the chemical deposit, it was possible to monitor the relative extent of the mercury leakage to the North Sea before and after the excavation of the deposit. The investigations have demonstrated the applicability of M. edulis as a monitoring organism for mercury when importance is attached to concentration gradients and distribution patterns in well defined and homogeneous samples of mussels collected from natural populations. (Author's abstract)
W84-05078

COMPARISON OF ISOLATION PROCEDURES FOR SALMONELLAS FROM POLLUTED WATER USING TWO FORMS OF RAPPAPORT'S MEDIUM,
Scottish Salmonella Reference Lab., Glasow.
C. R. Fricker.
Journal of Applied Bacteriology, Vol. 56, No. 2, p 305-309, April, 1984. 4 Tab, 19 Ref.

Descriptors: *Salmonella, *Bacterial analysis, Water analysis, Water pollution, Novobiocin.

The efficiency of Rappaport's broth (RB10) and Rappaport's broth containing novobiocin (NRB10) were compared for the isolation of salmonellas from polluted water, both as direct enrichment media and after pre-enrichment in buffered peptone water. Ninety samples were examined and 41 were found to contain salmonellas by at least one of the procedures used. Direct inoculation of the sample into RB10 resulted in the recovery of salmonellas from only 29.3% of the samples found to be positive. The use of NRB10 as a direct enrichment medium increased the percentage recovery to 78-0% of the total positive samples. Pre-enrichment in buffered peptone water allowed the recovery of salmonellas from a total of 41 samples whereas direct enrichment recovered them from only 32. No significant difference was demonstrated in the efficiencies of RB10 and NRB10 in recovering salmonellas after pre-enrichment in buffered peptone water. Three selective agars were used; no significant difference in their ability to recover salmonellae was demonstrated. (Author's abstract)
W84-05109

SENSORY ANALYSIS OF ODOROUS WATER SAMPLES,
Ghent Rijksuniversiteit (Belgium). Faculteit Landbouwwetenschappen.
H. R. Van Langenhove, D. Teerlinck, F. A. Van Wassenhove, and N. M. Schamp.
Journal of the Water Pollution Control Federation, Vol. 56, No. 4, p 351-354, April, 1984. 3 Fig, 2 Tab, 9 Ref.

Descriptors: *Water analysis, *Odors, Organoleptic properties, Pollutant identification, Chemical analysis, Dynamic olfactometry.

Results of the analysis of polluted water samples by the ASTM D 1292 method are compared with results obtained by dynamic olfactometry. The analysis showed the ASTM D 1292 method to be four times as sensitive as dynamic olfactometry. Moreover the variance among individual odor thresholds is significantly smaller in the ASTM D 1292 method. Comparing of results obtained by ASTM D 1292 at 40 and 20 degrees C shows that temperature difference enhances odor dilution ratios by a factor of two. The remaining difference between ASTM D 1292 and dynamic olfactometric results is attributed to methodological causes. From a practical viewpoint dynamic olfactometry is more convenient than ASTM D 1292. Dynamic olfactometric results are obtained within 1 hour, using a panel of 10 persons, while an analysis with ASTM D 1292 with five persons requires half a day. (Baker-IVI)
W84-05141

SOLVENT EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF PHOSPHATE WITH MOLYBDATE AND MALACHITE GREEN IN RIVER WATER AND SEA-WATER,
Okayama Univ. (Japan). Dept. of Chemistry.
S. Motomizu, T. Wakimoto, and K. Toei.
Talanta, Vol. 31, No. 4, p 235-240, April, 1984. 2 Fig, 6 Tab, 21 Ref.

Descriptors: *Water analysis, *Phosphates, *Spectrophotometry, Molybdate, Malachite green, River water, Seawater, Orthophosphate, Extraction.

Most spectrophotometric methods for phosphate are based on the formation of a heteropoly acid with molybdate. The heteropoly acid formed can be extracted into an organic phase, as an ion-pair with a cationic dye. An attempt was made to improve the extractability of the ion-pair formed between Malachite Green and molybdophosphate for use in this method. Molybdophosphate, formed between orthophosphate and molybdate in sulfuric acid solution, is extracted into a mixture of toluene and 4-methylpentan-2-one (1:3 v/v) with Malachite Green as counter-ion. A single extraction with equal phase volumes gives an apparent molar absorptivity for phosphate of 230,000 l/mole/cm at 630 nm; the absorbance of the reagent blank is 0.03. With an organic to aqueous phase-volume ratio of 1:10, the molar absorptivity is 250,000 l/mole/cm and the absorbance of the reagent blank 0.08. By the proposed method, ng/ml levels of phosphorus can be determined, and the detection limit is about 0.1 ng/ml. The standard deviation and relative standard deviation for the determination of phosphorus in tap water (4.3 ng/ml) are 0.05 ng/ml and 1.1%, respectively. The method can also be applied to the determination of phosphorus in river water and sea-water. Phosphorus occurs in natural water as orthophosphate, condensed phosphate and organically-bound phosphorus; only orthophosphate can be directly determined by this method. (Moore-IVI)
W84-05151

COMBINED EFFECT OF BODY SIZE, SEASON, AND LOCATION ON TRACE ELEMENT LEVELS IN MUSSELS (MYTILUS EDULIS),
Simon Fraser Univ., Burnaby (British Columbia). Dept. of Chemistry.
J. D. Popham, and J. M. D. Auria.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 1-14, January, 1983. 5 Fig, 5 Tab, 33 Ref, 3 Append. NSERC grants G0161 and G0507.

Descriptors: *Mussels, *Bioindicators, *Heavy metals, Trace elements, Monitoring, Seasonal variation, Body size, Marine environment, British Columbia.

Mussels are recognized as sentinels of heavy element marine pollution since their metal concentrations reflect the seawater concentrations in which they live. The usefulness of mussels as universal indicators may be dependent on the effects of other factors such as body size and season on heavy metal concentrations in specimens. Specimens of Mytilus edulis (mussels) were collected at one-month intervals over a one-year period from two locations in Burrard Inlet, British Columbia (B.C.) and less frequently from other locations in the S.W. region of B.C., and analyzed for concentrations of Mn, Fe, Cu, Zn, Br, Pb, and Sr using X-ray energy spectroscopy. Size and condition of the mussels were recorded at the same time. The data were analyzed using multiple linear regression with size and season as predictor variables and trace metal contents as criterion variables. Trace element concentrations in mussels are dependent upon body size and season of collection, and the way trace element concentrations are influenced by size and season is dependent upon the type of environment of the mussels. The values of the regression coefficients changed according to whether or not the mussels were collected from a polluted environment. Principal component analysis of the correlation matrix of the variables yielded three principal components one of which can be used to ascertain whether or not mussels were collected from either a polluted or an unpolluted environment. (Moore-IVI)
W84-05169

COPPER ACCUMULATION IN THE BAY SCALLOP, ARGOPECTEN IRRADIANS,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, and M. Johnson.

Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 127-133, March, 1983. 6 Fig, 2 Tab, 26 Ref.

Descriptors: *Scallops, *Copper, *Bioaccumulation, *Bioindicators, Heavy metals, Marine environment, Argopecten, Body size, Spawning.

The kinetics of copper accumulation by the bay scallop, Argopecten irradians, was studied to establich patterns and examine the bay scallop as a possible biological indicator of copper in nearshore marine waters. Adults of the bay scallop were held in flowing seawater containing 5 or 10 micro g Cu/kg at ambient temperature and salinity. After eight weeks, scallops contained up to 91 and 310 micro g Cu/g dry weight, respectively, in the total soft parts. Copper uptake was linear over time. There was no significant relationship between dry weight and copper content (micro g) in adductor muscle, visceral mass or total soft tissue. There was a significant inverse relation between dry weight and copper concentration (micro g/g) in adductor muscle, visceral mass, and total soft tissue. A decrease in copper content occurred in the visceral mass and total soft parts during spawning in the control and 5 micro g Cu/kg treatments. There was no apparent decrease in copper concentration during spawning in any tissue of scallops from all three treatments. A. irradians is an excellent bioindicator of copper, since accumulation was observed in the visceral mass at a seawater copper concentration of 1.8 micro g/kg. Size is an important consideration when sampling scallops from natural populations since small scallops appear to have higher concentrations of copper than large scallops. (Moore-IVI)
W84-05176

CONCENTRATIONS OF LEAD, CADMIUM, MERCURY, AND COPPER IN THE CRAYFISH (PACIFASTICUS LENIUSCULUS) OBTAINED FROM A LAKE RECEIVING URBAN RUNOFF,
Washington Univ., Seattle. Dept. of Environmental Health.
M. D. Stinson, and D. L. Eaton.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 693-700, November, 1983. 4 Fig, 3 Tab, 20 Ref.

Descriptors: *Crayfish, *Bioindicators, *Lead, *Cadmium, *Mercury, *Copper, Urban runoff, Heavy metals, Combined sewer overflows, Storm wastewater, Water pollution effects, Food.

Commercially caught crayfish (Pacifasticus leniusculus) were placed in a municipal lake below a combined sewer overflow outfall and a storm drain outfall associated with elevated sediment metal concentrations. Abdominal muscle, viscera, and exoskeleton from each crayfish were analyzed for mercury, cadmium, lead, and copper. Crayfish metal concentrations for each sampling site were evaluated relative to unexposed samples from the commercial catch and samples held in the laboratory. Results indicated that 1) mercury accumulated in muscle tissue, highest cadmium concentrations were in the viscera, and highest lead concentrations were in the exoskeleton, 2) uptake of copper is well-regulated by the organism at non-toxic water concentrations, and 3) viscera concentrations of cadmium, lead and copper tended to be higher and more variable than in muscle tissue. A significant correlation was found between body weight and muscle mercury concentration. Relative to allowable limits for metals in foods, there was not sufficient accumulation of any metal to indicate that a significant health hazard would result from consumption of these organisms. These data indicate that analysis of trace metals in various body parts of P. leniusculus may be a useful biological indicator of trace metal pollution of freshwater lakes and streams. (Author's abstract)
W84-05199

SOURCES OF VARIABILITY IN ACCUMULATION OF HEAVY METALS BY FISHES IN A ROADSIDE STREAM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
J. J. Ney, and J. H. Van Hassel.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 701-706, November, 1983. 1 Fig, 2 Tab, 44 Ref.

Descriptors: *Heavy metals, *Monitoring, *Fish, Roads, Bioaccumulation, Lead, Nickel, Cadmium, Zinc, Sunfish, Bass, Sucker, Dace, Darter, Variability.

Monitoring programs to assess heavy metals contamination of fish communities are hindered by the lack of a standard sampling protocol to control sources of extraneous variation. Such a protocol should include a rationale for specimen selection derived from an understanding of the factors that influence bioaccumulation of metals by fish. Interspecific variations in lead, nickel, cadmium, and zinc concentrations among six species of fish from a highway-contaminated stream were investigated as functions of differences in habitat (sediment contact) and morphology (percentage axial muscle). The species of fish studied include redbreast sunfish, rock bass, northern hog sucker, white sucker, blacknose dace, and fantail darter. Association with stream sediment appeared to influence whole-body metals accumulation but percentage muscle did not. Intraspecific variation in whole-body metal concentrations was not positively related to length (as an index of duration of exposure) in any species. Lead and nickel content of bone and cadmium content of kidney increased consistently between ages 2 and 5 in white sucker, the only species subjected to tissue analysis across age groups. Biological monitoring to assess chronic heavy metal pollution should focus on long-lived benthic species and be directed at tissues with demonstrated affinities for particular metals. (Moore-IVI)
W84-05200

ROLE OF MACROPHYTES IN AQUATIC ECOSYSTEMS AND MANAGEMENT OF FRESHWATER RESOURCES,
Kashmir Univ., Srinagar (India). Centre of Research for Development.
A. K. Pandit.
Journal of Environmental Management, Vol. 18, No. 7, p 73-89, January, 1984. 3 Fig, 9 Tab, 47 Ref.

Descriptors: *Macrophytes, *Water management, *Ecosystems, Lakes, Rivers, Aquatic plants, Aquatic fauna, Nutrients, Fish food, Pollutant identification.

Macrophytes, as a component of freshwater ecosystems, have diverse roles to play in the functioning of these ecosystems. The most important of their roles is in maintaining an ecological balance. Another possible use of aquatic plants, especially submerged species, is as green manure. Macrophytes are also useful indicators of water quality. Macrophytes also indicate habitat conditions such as the rate of flow and nature of the substrate. In addition to their use as food by aquatic fauna, macrophytes also provide suitable breeding and sheltering places for various aquatic fauna, the most favorable sites for breeding macro-invertebrates being the leaves and stems of submerged plants. Macrophytes, especially submerged species, support large quantities of a variety of epiphytic algae and a periphyton which is to some extent the life environment of invertebrates and fish. The nutritive importance of aquatic flora and the fauna feeding on them is depicted in a food web showing complex trophic relationships where a basic source of food energy is supplied by macrophytic plants. Analysis of data for 18 macrophytic species belonging to four different life-form types collected over a period of 6 months from Dal Lake revealed that most of the available foodstuffs contained rather high amounts of crude protein. Since they are such a vital part of freshwater ecosystems, macrophytes are important in the management of water resources. (Baker-IVI)
W84-05306

ANALYSIS OF ORGANIC COMPOUNDS IN WATER SAMPLES BY GAS CHROMATOGRAPHY - MASS SPECTROMETRY,
Indiana State Univ., Terre Haute. Dept. of Chemistry.
J. R. Siefker, and N. B. Sapuan.
Proceedings of the Indiana Academy of Sciences, Vol. 92, p 271-273, 1982. 2 Ref.

Descriptors: *Pollutant identification, *Organic compounds, Lakes, Wells, Wastewater analysis, Deming Park Lake, Dobbs Park Lake, Fowler Park Lake, Terre Haute, Indiana, Wabash River, Seymour, Toluene, Chloromethanes, Benzenes, Bromomethanes, Cyclohexanes, Naphthalenes.

The presence of volatile organic compounds was investigated in selected water samples collected from places where a certain degree of water pollution was suspected: including well water from several places in Indiana; Wabash River water; Deming, Dobbs and Fowler Park lake water; sewage treatment plant water; and tap water. A purge and trap method was used for the analysis. Some of the well water samples were taken from Seymour, Indiana. For 12 years more than 60,000 drums of chemical wastes were stored in Seymour's Freeman Field Industrial Park. A definite spectrum for toluene was obtained from some of the samples. While other spectra gave no definite results, 1-methyl naphthalene, 1,2-dimethyl naphthalene, and 1,1-biphenyl were indicated. Deming Park Lake water showed toluene and 1,2-dichloropropene; Dobbs Park Lake contained benzeneacetonitrile methylene. Walsh River water contained 1-ethyl-3 methylbenzene. Terra Haute Wastewater Plant samples gave spectra indicative of 3,3-dichloropropene, 1,2-dichlorobenzene, toluene, 1,4 dimethylbenzene, tetrachloroethane, and 1-(1-propynyl)-cyclohexane. One sample of Terra Haute tap water gave indication of dibromomethane and dibromochloromethane. (Baker-IVI)
W84-05309

LOW LEVEL SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF SULFITE IN WATER,
Los Angeles County Sanitation Districts, Whittier, CA.
J. E. Haskins, H. Kendall, and R. B. Baird.
Water Research, Vol. 18, No. 6, p 751-753, 1984. 2 Fig, 4 Tab, 4 Ref.

Descriptors: *Water analysis, *Wastewater analysis, *Sulfite, *Spectrophotometry, Sulfur dioxide, Acidity, Secondary wastewater treatment, Pollutant identification.

A method for determining low levels of sulfite in water is described based on the liberation of sulfur dioxide from an acidified water sample by purging with nitrogen gas and re-absorbing it in a solution containing ferric ion and 1,10-phenanthroline. The ferric ion is reduced to ferrous ion by the sulfur dioxide and the orange tris-(1,10-phenanthroline)iron(II) complex is formed. After removing the excess ferric ion with ammonium bifluoride to stop further color development, the stable complex is measured colorimetrically at 510 nm. The detection limit is 0.01 mg/l sulfate. The method is subject to several possible interferences. Sulfamic acid is added to remove nitrite as a negative interference. Sulfide and thiosulfate will give a positive interference if present, but these would normally be expected only in samples containing certain industrial discharges. Sulfide may be removed by adding 0.5 g zinc acetate with sufficient sodium hydroxide solution to produce a fast settling floc, and analyzing the supernatant of the settled sample. If thiosulfate is present it is necesary to differentiate between sulfite and thiosulfate by using the iodometric titration method with and without the elimination of sulfite by a 5 min reaction with 2 ml formaldehyde. This method may be a suitable alternative to the iodometric titration procedure when analysis of low levels of sulfite ion in water and wastewater is desired. (Baker-IVI)
W84-05321

COMPARISON OF SEDIMENTS AND ORGANISMS IN IDENTIFYING SOURCES OF BIOLOGICALLY AVAILABLE TRACE METAL CONTAMINATION,
Geological Survey, Menlo Park, CA.
E. A. Thomson, S. N. Luoma, C. E. Johansson, and D. J. Cain.

Water Research, Vol. 18, No. 2, p 755-765, 1984. 8 Fig, 25 Ref.

Descriptors: *Sediments, *Bioindicators, *Pollutant identification, San Francisco Bay, Metals, Copper, Zinc, Lead, Urban runoff, Trace metals, Harbors, Bays.

Sediments and an indicator organism were used to assess the relative importance of secondary sewage, urban runoff, a landfill containing metal-enriched ash wastes and a yacht harbor in contributing to Ag, Cu and Zn enrichment in South San Francisco Bay. Spatial gradients in sediments and organisms showed Cu and Ag enrichment originated from sewage discharge, whereas Zn enrichment orginated from both sewage and urban runoff. Elevated concentrations of Cu in the sediments of the yacht harbor resulted from a high abundance of fine particles. The biological availability of Cu, Ag and Zn did not coincide with metal enrichment in sediments. The availability of Cu and Ag was greatest nearest the sewage outfall and greater in winter and spring than in summer. The availability of Zn in urban runoff appeared to be lower than the availability of Zn associated with sewage. Where metal concentrations in sediment were elevated simply because of the presence of finer particles, no elevation of metal levels in clams occurred. If organisms are to be used to detect or differentiate sources of pollution, sampling sites must be chosen carefully, especially in water bodies where circulation patterns are poorly known. Sediment analyses proved useful in this study for verifying the presence, and the source, of trace metal contaminants, proving that trends in animals were not the result of purely physiological processes. However, the biological availability of the metal contaminants was not related solely to the concentration of metal discharged or present in the sediment. Compared to sediments, oganisms exhibited greater spatial sensitivity, a greater ability to concentrate metals, and were the more reliable tool for identifying sources of biological contamination. (Baker-IVI)
W84-05322

USE OF SYNCHRONIZED ANALYZERS IN AUTOMATIC WATER QUALITY CONTROL (ZUM EINSATZ VON TAKTANALYSATOREN IN DER AUTOMATISCHEN WASSERBESCHAFFENHEITSKONTROLLE),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
H. Heitmann.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 164-167, May, 1983. 2 Fig, 13 Ref.

Descriptors: *Water quality control, *Water analysis, *Synchronized analyzers, Chemical analysis, Calorimetry, Monitoring.

The effectiveness of automatic water quality control in water and wastewater treatment depends to a great extent upon the availability of analyzers for specific substances found in water, particularly for salt, nutrients, and harmful pollutants. The synchronized analyzer system at the Dresden (German Democratic Republic, GDR) Control Facility is an example of this, and is available in two modes: as titrator with potentiometric point-of-equivalence indication, and as calorimeter. The Dreloba system, developed in the GDR, illustrates the principles of synchronized analyzers: it consists of modules for digital control under pneumatic normal and low-pressure conditions. The analyzer must be installed indoors, with easily accessible supplies of electricity, compressed air, and water samples. The water to be tested usually flows through the dose unit constantly unless it is polluted with particles that clog the valve seat, in which case the valve is programmed to open for a limited time. Analyses can be automatically timed to suit water flow speeds and programmed to omit unnecessary steps, resulting in cost savings. For the monitoring of water polluted with salt, routine conductivity measurements are complemented by automatic potentiometric titrations to determine total water hardness and chloride and hydrocarbon contents. Successful use of the synchronized analyzer as colorimeter depends (in contrast to its use as titrator) on pretreatment of the water sample to remove turbidities. Although progress has recently been made in automatic sample filtration techniques, adequate treatment levels cannot be achieved for all applications. In addition, colorimetric reactions can be handled more easily in an acid environment. The synchronized analyzer can also be used in the automatic conditioning of samples for discontinuous measurement of specific ion activity with sensitive electrodes (e.g., for cyanide analysis, which requires alkalization of the sample). In the titrator with potentiometric indication system mode, the analyzer is universally applicable. (Gish-IVI)
W85-04799

5B. Sources Of Pollution

IDENTIFICATION OF FACTORS AFFECTING NITROGEN AND PHOSPHORUS LOADINGS TO LOUGH NEAGH,
Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
R. H. Foy, R. V. Smith, R. J. Stevens, and D. A. Stewart.
Journal of Environmental Management, Vol. 15, No. 2, p 109-129, September, 1982. 5 Fig, 10 Tab, 46 Ref.

Descriptors: *Nitrogen, *Phosphorus, *Pollution load, *Lough Neagh, *Water pollution sources, Multiple regression analysis, Cycling nutrients, Fertilization.

A stepwise multiple regression analysis was used to identify the factors affecting nitrogen (N) and phosphorus (P) loss rates from six major rivers entering Lough Neagh over the period 1971-1979. Nitrate-N, Kjeldahl-N, soluble reactive P (SRP), soluble organic P (SOP) and particulate P (PP) were analyzed with independent catchment variables reflecting population, land use, industry and run-off rate. Urban population density was the dominant factor accounting for 44.0% of the variability of the SRP regression and the predicted per capita value (1.6 g P/person/day) agreed well with the observed value (1.8 g P/person/day). Milk processing plants contribued 4.6% of the variability and the predicted output was close to field measurements. The log of run-off was also an important determinant and contributed a further 20.8% of the variability, but all of the other variables failed to meet the criterion of significance. Intensity of dairy farming, shown to be highly correlated with N fertilizer usage, contributed 56.7% of the variability to the nitrate-N regression. Twelve % of the N fertilizer applied was lost in drainage water. The log of run-off contributed 21.4% of the variability and roughland was negatively correlated. All point source variables failed to meet the criterion of significance. Of the remaining chemical variables, only the PP regression produced a high R2 value, with the log of run-off being the dominant variable accounting for 43% of the variability. The regression equations were used to calculate total annual inputs to Lough Neagh of SRP and nitrate-N. A rise in the N/P ratio with time was observed. The SRP input could be reduced by 42%, if 90% P removal was practiced at the 18 largest sewage works. (Author's abstract)
W84-04816

INVESTIGATION OF SOURCES OF GROUNDWATER NITRATE CONTAMINATION IN THE BURBANK - WALLULA AREA OF WASHINGTON, U.S.A.,
Nebraska Univ., Lincoln. Conservation and Survey Div.
R. F. Spalding, M. E. Exner, C. W. Lindau, and D. W. Eaton.
Journal of Hydrology, Vol. 58, No. 3/4, p 307-324, September, 1982. 5 Fig, 2 Tab, 48 Ref.

Descriptors: *Water pollution sources, *Groundwater pollution, *Nitrates, *Burbank, *Wallula, *Washington, Water quality, Agricultural wastes, Leachates, test wells, Walla Walla county.

During the past decade the increased emphasis on the quality of drinking water has resulted in expanded groundwater for drinking. The most commonly reported chemical contaminant is nitrate. During the fall and early winter of 1980, groundwater samples were collected from 38 public supply and domestic wells in the Burbank-Wallula area of Washington. Groundwater nitrate-nitrogen (NO3-N) concentrations ranged from 3.9 to 32 mg/l and averaged 10.5 mg/l. Nitrogen isotope composition (delta N-15) of the NO3-N ranged from +1.3 to +16.0 0/00 and averaged +4.1 0/00. The preponderance of low delta N-15 values suggests that agricultural leachates (from oxidation of soil humus or use of nitrogen fertilizers) are the primary source of contamination for the area. Fourteen of the 38 wells were sampled at least twice in a four-month period. The relative invariability in NO3-N levels and delta N-15 in these wells suggests little or no temporal change in either the source or the magnitude of the source. Two additional samples collected in May 1981 from monitoring wells on the perimeter of a cropped field spray-irrigated with cattle waste from an anaerobic lagoon had delta N-15 values for the NO3-N of +12.0 and +18.7 0/00, respectively. The high delta N-15 values in these wells indicate that the NO3-N is predominantly derived from animal waste. (Murphy-IVI)
W84-04853

LEACHING OF A SOLUBLE CHEMICAL UNDER FIELD CROP CONDITIONS,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
S. J. Smith, L. R. Ahuja, and J. D. Ross.
Soil Science Society of America Journal, Vol. 48, No. 2, p 252-258, March-April, 1984. 3 Fig, 1 Tab, 33 Ref.

Descriptors: *Leaching, *Bromide, *Root zone, *Sorghum-sudangrass, Soil water, Soil profiles, Burns' equation, Levin's equation, Convective-dispersive transport equation, Dispersion coefficient, Plant water potential, Flow velocity.

Movement of relatively nonadsorbed, applied, soluble chemicals is soils plays an important role in determining their availability to plants and associated potential for posing environmental hazards. The leaching pattern of surface-applied bromide is examined in an active rootzone of a sorghum-sudangrass (Sorghum sudanense (Piper) Stapf) crop in Southern Plains field plots. Data were collected for eight soils, comprising five soil orders, over three growing seasons. The position of the leaching front (solute center of mass) was better predicted generally by Burns' equation, which assumes chromatographic-type, sequential mixing of solute with soil water, than by Levin's equation, which assumes the leaching front moves with the velocity of water flowing above field capacity. With both equations effective rainfall was used, by correction for the soil water deficit caused by evapotranspiration above the leaching front. The leaching pattern in the soil profile was described quite well by a simplified version of the convective-dispersive solute transport equation, which assumed constant average values for the dispersion coefficient, D, a plant uptake factor, beta, and flow velocity. Plant uptake of solute was assumed to be proportional to its concentration in soil water during passage through the root zone, with an effective average value of the proportionally constant applicable on a seasonal basis. The average value of D among soils was fairly uniform, 1.36 + or - 0.56 sq cm/d. Therefore, in practice a single value of D will probably suffice for many soils and conditions. Necessary inputs for obtaining flow velocity can be obtained from plant growth and water balance components of CREAMS, or other appropriate models. In the case of beta, some additional information is needed regarding its relationship to specific growth factors. (Murphy-IVI)
W84-04873

METHODOLOGIES TO PREDICT THE MOBILITY AND AVAILABILITY OF HAZARDOUS METALS IN SLUDGE-AMENDED SOILS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, J. P. LeClaire, and C. S. LeVesque.

Available from the National Technical Information Service, Springfield, VA 22161 as PB84 171099, Price codes: A09 in paper copy, A01 in microfiche. California Water Resources Center Completion Report, Univ. of California, Davis, January, 1984. 156 p, 4 Fig, 4 Tab, 74 Ref.

Descriptors: *Trace metals, *Wastewater, *Sludge, *Sludge disposal, *Solubility, *Effluents, *Soil contamination, Soil chemistry, Bioaccumulation, *Soil disposal fields, Land disposal, Nickel, Copper, Zinc, Cadmium, Lead, Sludge application rates.

Research was undertaken to develop practicable laboratory methods for assessing the solubility and plant-availability of potentially hazardous trace metals accumulating in arid-zone soils receiving sewage effluents or sludges. Sequential extraction of field soil samples with potassium nitrate, water, sodium hydroxide, sodium EDTA, and nitric acid was shown to provide reliable estimates of trace metal solubility and uptake (leaf concentration) by barley, irrespective of soil texture, rate of sludge application, or time during a three-year study period. The total concentrations of the trace metals Ni, Cu, Zn, Cd, and Pb accumulated in two sludge-amended field soils during the project period were comparable with the amounts of these metals sorbed by untreated soils at soil solution concentrations below 100 parts per billion. At these low metal concentrations, the sorption isotherms often exhibited a sigmoid shape that precludes intrepretation of terms of conventional distribution function techniques. Organic forms of the trace metals, particularly copper, were found to increase in importance with the sludge application rate. These organic-metal compounds could be characterized conveniently by electron spin resonance spectrometry. (Snyder-California)
W84-04886

VERTICAL TRANSPORT AND SEDIMENTATION OF HYDROCARBONS IN THE CENTRAL MAIN BASIN OF PUGET SOUND, WASHINGTON,
National Oceanic and Atmospheric Administration, Washington, DC.
T. S. Bates, S. E. Hamilton, and J. D. Cline.
Environmental Science and Technology, Vol. 18, No. 5, p 299-305, May, 1984. 4 Fig, 4 Tab, 30 Ref.

Descriptors: *Sediment transport, *Sedimentation, *Hydrocarbons, *Puget Sound, *Washington, Sedimentation rates, Water pollution, Pollutants, Pollution load, Accumulation.

Hydrocarbons are introduced into the surface waters of the marine environment from runoff and erosion, effluent discharges, atmospheric deposition, and biological sources. Concentrations and vertical fluxes of total carbon, aliphatic hydrocarbons, and polycyclic aromatic hydrocarbons (PAH) were determined in suspended matter and the underlying sediments in the central main basin of Puget Sound, Washington. Suspended matter was collected seasonally at four depths in the water column using sequential sampling sediment traps. The flux of PAH through the 50- and 100-m horizons accounted for 84% of the PAH accumulating in the underlying surface sediments. The concentration of PAH in the suspended matter from these traps, however, was 3 times greater than the concentration of PAH in the surficial bottom sediments. Laterally transported suspended matter in the bottom boundary layer is apparently diluting the PAH during sedimentation. The flux of aliphatic hydrocarbons to the sediments was greater than the accumulation rate in the sediments, indicating an alteration of these hydrocarbons within the water column or differential particle transport. The vertical distributions of hydrocarbons in the bottom sediments showed concentration increases paralleling the urbanization of the Puget Sound basin. (Murphy-IVI)
W84-04890

CHROMIUM UPTAKE AND LOSS IN THE BIVALVES CRASSOSTREA VIRGINICA AND MYTILUS EDULIS,
Environmental Research Lab., Narragansett, RI.
G. E. Zaroogian, and M. Johnson.
Marine Ecology - Progress Series, Vol. 12, No. 2, p 167-173, May, 1983. 3 Fig, 21 Ref.

Descriptors: *Bioaccumulation, *Chromium, *Crassostrea, *Mytilus, Mussels, Bioindicators, Biological magnification, Trace metals, Trace levels.

Chromium uptake and loss by the bivalves Crassostrea virginica and Mytilus edulis were studied at naturally occurring seawater temperature and salinity to determine their potential as an indicator of chromium pollution. After 12 wk treatment with 5 and 10 ppb Cr seawater, mean tissue concentration in oysters, C. virginica, was 3.12 + or - .45 and 5.63 + or - 1.15 micro g Cr/g dry weight, respectively. Mean chromium concentration in mussels, M. edulis, treated with 5 and 10 ppb Cr seawater for 12 wk were 4.83 + or - 1.32 and 9.41 + or - 3.37 micro g Cr/g dry weight, respectively. Significant linear relationships exist between chromium uptake by oysters and mussels and seawater chromium concentrations over the range of concentrations used in this study. A significant inverse relationship exists between tissue chromium concentration and dry weight in both oysters and mussels. Chromium concentration in oysters continued to increase during spawning, whereas it decreased in mussels. After holding chromium treated mussels in ambient flowing seawater for 28 wk, a 61 and 70% loss of chromium occurred in mussels treated with 5 and 10 ppb Cr, respectively. When treated similarly, oysters from both 5 and 10 ppb Cr treatments lost 42% of their tissue chromium after 28 wk depuration. Evidence is presented which suggests that oysters would be a better indicator of chromium pollution of the environment than mussels. (Author's abstract)
W84-04899

CHEMICAL AND THERMAL LOADS OF THE DANUBE AND ITS TRIBUTARIES (UBER CHEMISCHE UND THERMISCHE BELASTUNGEN DER DONAU UND IHRER NEBENFLUSSE),
Bulgarian Academy of Sciences, Sofia. Inst. of Hydrology and Meteorology.
K. I. Sofia.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 181-193, 1982. 2 Fig, 2 Tab, 27 Ref.

Descriptors: *Danube River, *Chemical wastes, *Thermal pollution, *Water quality management, *Water quality standards, Water pollution prevention, Water pollution control, Water management, Water use, Industrial wastes, Water pollution sources.

The Danube and its tributaries must increasingly support demographic growth, new plant discharges and increased water demand. As a whole, the tributaries which are abundant in water and the rather large riparian towns bring but local changes in the degree of the load that must be supported by the Danube water. The situation regarding dissolved oxygen has clearly deteriorated on the whole course of the river. At high level, the dissolved oxygen content gradually sinks to 9-12 mg/l in the water of the upper reaches and to 5-8 mg/l in the lower reaches. Even higher and more dangerous is the proportion of mineral oils, biocides, heavy metals and radioactive waste products in the chemical pollution of the Danube. In the future, the thermal load will be just as important due to the intensive construction of thermonuclear plants on the shores of the Danube. In spite of the heavy load that has to be supported by the Danube this river can still be classified as a relatively clean body of water, thanks to its self-purifying and dilution capacity. In order to prevent the increase of the pollution of the Danube, some decisive and urgent decontamination measures should be taken and the industrial and municipal waste waters should be purified before entering the Danube and its tributaries. Such measures must include the construction of new waste water treatment plants and the restoration of older ones. It will also be necessary in the coming years to set up standardized specifications for the tolerable levels of pollution in river waters; such standards will have to be set up in international cooperation and will be binding for all the riparian states of the Danube. It will also be necessary to pass an international convention regarding the quality of the Danube water. What is needed is an alarm system on the whole course of the Danube which will report any accidental and disastrous case of pollution. The quality of the Danube water can only be attained through the cooperation of all the riparian states. (Murphy-IVI)
W84-04907

RADIOECOLOGICAL PROBLEMS IN THE DANUBE DRAINAGE AREA (RADIOOKOLOGISCHE PROBLEME IM DONAUEINZUGSGEBIET),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
K. Hubel.
Schweizersche Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 194-203, 1982. 11 Ref.

Descriptors: *Radioecology, *Danube River, *Drainage area, Radioactive wastes, Nuclear powerplants, Tritium, Strontium, Isotopic tracers, Radionuclides, Path of pollutants, Model studies.

In the Danube area there are nuclear plants with an electricity output of 2 GW, with anticipated increases well around six times greater by the end of the century. A model is described to track the main exposure paths of nuclear plant discharges in Europe. Special reference is made to the importance of marginal ecological conditions caused by the behavior of radionuclides in the aquatic biosphere. Mention is made of the possibilities of determining them from emission and immission measures. The radionuclide tritium has been tracked through the Danube and its tributaries. The gamma-spectrograph is used to analyze nuclides in water and in hydrobiological material to determine their concentration. The concentration of strontium isotopes is also determined. All the results are in the same order of magnitude. Part of the data regarding doses has also been calculated. (Murphy-IVI)
W84-04908

MERCURY ACCUMULATION BY FILAMENTOUS ALGAE: A PROMISING BIOLOGICAL MONITORING SYSTEM FOR METHYL MERCURY IN ACID-STRESSED LAKES,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
P. M. Stokes, S. I. Dreier, M. O. Farkas, and R. A. N. McLean.
Environmental Pollution (Series B), Vol. 5, No. 4, p 255-271, 1983. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Bioindicators, *Bioaccumulation, *Aquatic plants, *Algae, *Methyl mercury, *Acidic water, Water pollution effects, Hydrogen ion concentration, Monitoring.

One of the potential effects of lake acidification is related to the demonstrated negative correlation between mercury in fish and pH of lake water. To date, this relationship has not been shown for other aquatic biota. The present study was designed to determine total and methyl mercury in filamentous green algae collected from natural and artificial substrates in eleven lakes (pH 4.5-7.2) on the Precambrian Shield of south-central Ontario. When grown on artificial substrates, these algae, which are abundant in acid-stressed sites, showed considerable promise as monitors of mercury. Intra-site variation in mercury content was low and inter-site differences were significant. The mercury was almost entirely methyl mercury. In contrast, mercury in algae from natural substrates showed more variation and lower proportions of methyl mercury. The mercury content of the algae showed no relationship to mercury in the sediment or water, but was of the same magnitude as, and significantly correlated with, mercury in the flesh of yearling perch collected from the same acid-stressed lakes three years previously. In the fish study, a strong inverse relationship was observed between the mercury content of the perch and the pH of the water. The results indicate that the uptake of methyl mercury into both fish and algae may be primarily determined by the availability of methyl mercury in water. The algae show promise as a

cheap and rapid method for monitoring methyl mercury availability in acid-stressed lakes. (Author's abstract)
W84-04941

DIHALOACETONITRILES IN DRINKING WATER: ALGAE AND FULVIC ACID AS PRECURSORS,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver.
Environmental Science and Technology, Vol. 17, No. 2, p 80-83, February, 1983. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Drinking water, *Organic compounds, *Dihaloacetonitriles, Fulvic acid, Algae, Water treatment, Chlorination, Water pollution sources, Scenedesmus, Anabaena.

Chlorinated drinking water samples from 10 locations in southern Ontario were found to contain dihaloacetonitriles, DHAN's. All samples contained CHCl2CN (ranging from 0.3 to 8.1 ppb) and some contained CHBrClCN (ranging from not detectable to 1.8 ppb). The average molar DHAN concentration was about 10% of the average molar trihalomethane concentration. The concentration of dihaloacetonitriles found in several southern Ontario water supplies can be produced by chlorinating aquatic humic substances and algae under the conditions used for water treatment. Of the two algae species tested, the blue-green Anabaena Texas 1447, which had a much higher organic nitrogen content, produced considerable more DHAN's on chlorination than the green Scenedesmus basiliensis. (Baker-IVI)
W84-04943

THERMAL AND METABOLIC FACTORS AFFECTING PCB UPTAKE BY ADULT BROWN TROUT,
Argonne National Lab., IL. Radiological and Environmental Research Div.
For primary bibliographic entry see Field 5C.
W84-04944

EFFECT OF NUTRIENTS ON THE RATES OF MINERALIZATION OF TRACE CONCENTRATIONS OF PHENOL AND P-NITROPHENOL,
Cornell Univ., Ithaca, NY. Lab. of Soil Microbiology.
H. E. Rubin, and M. Alexander.
Environmental Science and Technology, Vol. 17, No. 2, p 104-107, February, 1983. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Mineralization, *Phenol, *Nitrophenol, *Nutrients, *Trace levels, Nutrient requirements, Arginine, Yeast, Water properties, Chemical properties.

The rates of phenol mineralization in samples of three lakes were directly proportional to concentration at phenol levels of 2.0 pg/mL to 200 ng/mL. The rate at any one concentration was related to the trophic level of the water. In samples containing microbial cells collected from the eutrophic lake, reducing the nutrient supply decreased the mineralization rate. Inorganic nutrients, arginine, or yeast extract often enhanced but glucose reduced the rate of mineralization. Arginine was not stimulatory in stream water. Mineralization was slower than predicted at phenol concentrations of 1.5 pg/mL or less but occurred at predicted rates in the presence of arginine. Arginine also stimulated the mineralization of 19-197 pg of p-nitrophenol/mL by lake water microorganisms, but only at one p-nitrophenol concentration was it stimulatory in stream water. Organic and inorganic nutrients in natural waters affect the rate of mineralization of organic compounds in trace concentrations. (Murphy-IVI)
W84-04945

NITROGEN SOURCE EFFECT ON NITRATE AND AMMONIUM LEACHING AND RUNOFF LOSSES FROM GREENS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, J. C. Thomas, and R. L. Duble.
Agronomy Journal, Vol. 74, No. 6, p 947-950, November-December, 1982. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Leaching, *Water pollution sources, *Golf courses, *Nitrates, *Ammonium, Infiltration rate, Fertilizers, Runoff, Milorganite, Ureaformaldehyde, Isobutylenediurea, Ammonium nitrate, Soil types.

The use of sandy rooting media with rapid infiltration rates in the construction of golf greens provides the potential for N pollution of nearby water supplies. This study was designed to measure the effects of different N sources on NO3(-) and NH4(+) concentrations in leachate and runoff from golf greens constructed with various rooting media. Individual golf greens with USGA-type profiles were constructed in the field with upper 30 cm layers consisting of sand-peat, sand-soil-peat and sandy loam soil mixtures. All profiles were equipped with subsurface tile drains over a plastic sheet and were treated sequentially with the following N fertilizers: NH4NO4, ureaformaldehyde, 12-12-12, Milorganite, and IBDU. Leachate and runoff were collected and analyzed for NO3(-) and NH4(+). Nitrate concentrations in leachate from sand, mixed, and soil greens fertilized with quick release materials ranged from 45 to 326, 8 to 314 and 8 to 170 mg/liter, respectively and remained in this range for a 3-week period. Runoff concentrations from the greens constructed of sandy loam soil exceeded 30 mg/liter. No runoff was collected from sand or mixed greens. Nitrate N losses from various sources were in the order of NH4NO3 > 12-12-12 > Milorganite > isobutylenediurea (IBDU) > ureaformaldehyde. Isobutylenediurea provided a very uniform release rate. Milorganite had a 25 to 30 day delay before NO3(-) appeared in the leachate. Soluble sources, NH4NO3, and 12-12-12 exhibited leaching within 5 days after application. It appears that regular moderate applications of slow release N sources would provide minimum NO3(-) loss while supplying a continuous N supply. Ammonium losses ranked from greatest to smallest were NH4NO3 > Ureaformaldehyde > Milorganite > 12-12-12 > IBDU. Ammonium losses contributed very little to the total N losses from golf greens. Highest total N loss was 23% of the applied N. (Author's abstract)
W84-04994

CHEMICAL CHARACTERISTICS OF SURFACE RUNOFF FROM SOILS AND REVEGETATED LIGNITE MINE SPOILS,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, J. C. Thomas, and L. E. Deuel, Jr.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 146-149, March-April, 1984. 4 Fig, 1 Tab, 9 Ref. BM grant J0295016.

Descriptors: *Spoil banks, *Texas, *Water pollution sources, *Land reclamation, Surface runoff, Topsoil, Lignite, Water quality, Revegetation, Storm runoff, Hydrogen ion concentration, Conductivity, Iron, Manganese.

Surface runoff from three revegetated lignite mine spoils and nine native soils on three geological deposits along the Texas Gulf Coast were evaluated. Purpose was to compare water quality from revegetated, nontopsoiled spoils with that from undisturbed soils. Field plots 4.6 x 9.5 m x 10 m deep were established on revegetated, nontopsoiled test pits at each geological deposit and on three soils representative of each of the three areas to be mined. Stormwater runoff from natural rainfall events was sampled following major storms and analyzed for pH, electrical conductivity (EC), soluble Fe, and Mn. Although runoff water pH from revegetated spoil on the Jackson deposit was low initially, a slow increase occurred during the first 15 months after revegetation. Runoff pH from spoils was eventually similar to that from soils. Runoff water pH from revegetated spoil on the other two geological deposits was similar to that from the soil during the first 15 months after revegetation. EC of runoff water from revegetated spoil was less than 3 dS/m for all sites immediately after revegetation and declined to background levels within 1 year. Concentrations of Fe in runoff exceeded 3.5 mg/l during the first 6 months following revegetation; however, later concentrations were similar to those from soils. The Fe concentration in runoff from the Jackson deposit spoil and topsoils was low, but the concentration from spoil increased slightly with time. The concentration of soluble Mn in runoff was initially greater than 2.0 mg/l from revegetated spoil on the Jackson and Claiborne deposits but declined to background levels after 4 months. Initially, EC and soluble Fe and Mn concentrations in runoff from revegetated spoil on several of the deposits studied were greater than desirable. However, they reached concentrations comparable to those in runoff from adjacent soils within 4 to 15 months after the initial phases of revegetation. (Author's abstract)
W84-05057

DISTRIBUTION OF ALKYL LEAD SPECIES IN THE MERSEY ESTUARY,
Liverpool Univ. (England). Dept. of Oceanography.
J. P. Riley, and J. V. Towner.
Marine Pollution Bulletin, Vol. 15, No. 4, p 153-158, April, 1984. 10 Fig, 1 Tab, 18 Ref.

Descriptors: *Alkyl lead compounds, *Mersey Estuary, *Manchester Ship Canal, *England, Lead, Estuaries, Water pollution sources, Tetra-alkyl lead, Industrial wastes, Lead compounds.

The Mersey is unique among British estuaries in receiving the waste from a plant producing tetra-alkyl lead as an anti-knock ingredient for gasoline. The effluent is discharged continuously at Ellesmere Port into the Manchester Ship Canal. Differential pulse anodic stripping voltammetry was used to study the distribution of dissolved inorganic lead, and di- and tri-alkyl lead species in the Mersey Estuary and the Manchester Ship Canal. The concentration of total alkyl lead in the Manchester Ship Canal decreased for the high value of 4.7 x 10 to the -7 mol/l near the effluent discharge to less than one-twelfth of this value at the Weaver sluices. At all stations seawards of the point of discharge into the estuary the total concentration of alkyl lead was 5-10 times that of dissolved inorganic lead. In general, di-alkyl lead constituted about one-tenth of the total alkyl lead. The total alkyl lead concentration behaves conservatively in the estuary, in line with the stability and low adsorbability of these compounds. In contrast, inorganic lead shows a strongly non-conservative behavior. Concentrations of total alkyl lead in the Ship Canal are much higher than those in the estuary. (Moore-IVI)
W84-05080

COAL MINE DRAINAGE IN THE UNITED STATES - AN OVERVIEW,
Pennsylvania State Univ., University Park. Coll. of Earth and Mineral Sciences.
H. L. Lovell.
Water Science and Technology, Vol. 15, No. 2, p 1-25, 1983. 5 Fig, 5 Tab, 60 Ref.

Descriptors: *Mine drainage, *Water pollution control, *Coal mining, Water quality control, Acidity, Wastewater treatment, Pyrite oxidation, Bacteria, Permits, Legal aspects, Legislation.

The mining of coal disturbs the near surface strata to modify geohydrology and enhances the opportunities for pyrite to oxidize forming water soluble acidic compounds. Laws and complex regulations of the Federal and State governments, functioning through a permit system, require specific planning and operations to achieve minimum environmental change. The permit system involves pre-mine planning, bonding, inspection, enforcement and prompt reclamation. By maintaining an alkaline environment, seeking isolation of the reactive components, and applying numerous specialized mining practices their effects on water quantity and quality variation can be substantially controlled. Only when unavoidable conditions exist must degraded waters be treated to avoid ecological changes in receiving streams and hydrologic systems. Control

approaches to minimize changes in water quantity and quality have evolved in the past two decades by law regulation, industry coordination, and research. Preventive control is sought rather than practice treatment to meet effluent guidelines for minimum quality. A tonnage production fee funds restoration of pre-law abandoned mine conditions. The bases of control are: hydrologic budget maintenance, sedimentation to reduce particle transport and suspended solids, evaluate strata alkalinity and sulfide content, and maintenance of an alkaline strata environment for sulfide stability. (Baker-IVI)
W84-05086

REVIEW OF WATER POLLUTION PROBLEMS AND CONTROL STRATEGIES IN THE SOUTH AFRICAN MINING INDUSTRY,
J. O. Kempe.
Water Science and Technology, Vol. 15, No. 2, p 27-58, 1983. 7 Fig, 9 Tab, 19 Ref.

Descriptors: *Water quality control, *Water pollution control, *South Africa, Review, Salinity, Legislation, Effluents, Water conservation, Industrial wastes, Water reuse, Wastewater treatment, Mining.

South Africa's exploitable water resources are limited, and these resources are being seriously polluted in some areas, notably in the Vaal River catchment. During winter months and periods of drought mineral salt loads in the Vaal Barrage catchment have already reached critical peaks for certain industrial uses. It is becoming increasingly important to take both short term and long term action in order to safeguard water supplies and preserve their quality. Strict application of statutory and regulatory tools are insufficient in themselves to have the desired effect. Maintaining increases in industrial cooperation is essential to achieve required goals. A number of individual striking achievements of effluent recycle, water conservation and effluent purification, particularly among larger industries have been made, but it is necessary for industry as a whole, no matter how small the use of water, to review critically its water and effluent management. Positive action from all quarters has become an urgent necessity for the protection of the limited water resouces of the country. Special attention is given to the mining industry and its use of water and discharge of effluents in South Africa. (Baker-IVI)
W84-05087

MINE WATER POLLUTION - AN OVERVIEW OF PROBLEMS AND CONTROL STRATEGIES IN THE UNITED KINGDOM,
National Coal Board, London (England).
H. G. Glover.
Water Science and Technology, Vol. 15, No. 2, p 59-70, 1983. 1 Fig, 3 Tab, 4 Ref.

Descriptors: *Coal mining, *Water pollution control, *Great Britain, Water management, Surplus water, Water reuse, Salinity, Pyrite, Suspended sediments, Water quality control.

The management of water within the British coal mining industry and the means by which surplus waters are discharged to the environment without serious effect are described. The acquisition, use, treatment and re-use of water is detailed with particular emphasis placed on the control of the volume and quality of surplus water generated. The total average daily volumes of water involved in the British coal mining industry are illustrated. Water is acquired from rivers, streams, wells, boreholes, rainfall, and underground and opencast mine workings. Surplus water is generated during nine coal mining activities; baths, canteens and offices; steam-raising and cooling; coal preparation; underground mine drainage; spoil heaps; coal stock-piles; colliery surfaces and buildings; and abandoned mines. Treatment is used to reduce the salinity of coal mine surplus waters, remove the excessive concentrations of suspended mineral particles, and remove pyrite oxidation products. (Baker-IVI)
W84-05088

DEPOSITION OF ACIDIC COMPONENTS AND HEAVY METALS IN THE FEDERAL REPUBLIC OF GERMANY FOR THE PERIOD 1979-1981,
Frankfurt Univ. (Germany, F.R.). Inst. fuer Meteorologie und Geophysik.
H. W. Georgii, C. Perseke, and E. Rohbock.
Atmospheric Environment, Vol. 18, No. 3, p 581-589, 1984. 10 Fig, 1 Tab, 18 Ref.

Descriptors: *Deposition, *Heavy metals, *West Germany, *Acids, Aerosols, Fallout, Precipitation, Sulfates, Nitrates, Chlorides, Water pollution sources.

Measurements of wet and dry deposition of sulfate, nitrate, chloride and heavy metal aerosols were obtained from a network in the Federal Republic of Germany during 1979 to 1981. Wet deposition was the dominant sink-mechanism for the anions sulfate, nitrate and chloride as well as for the heavy metal-aerosols lead and cadmium which occur in the fine-particle mode. Only for heavy metal-aerosols in the size range above 1 micro m radius like Mn and Fe does dry deposition exceed wet deposition. In contrast to ambient sulfate and nitrate concentrations the spatial distribution of sulfate and nitrate concentration in rainwater is more homogeneous. The main fraction of acidifying anions in precipitation consists of sulfate (50-60%) with the contribution of nitrate amounting to 25-30%. Wet deposition-pattern of acidifying anions in remote areas is mainly determined by the rainfall pattern. Wet deposition rate of sulfate and nitrate is higher during summer than during winter. The trace substance concentration in rainwater decreases during the course of individual cases of rainfall. Highest concentrations are observed at the onset of rainfall. (Baker-IVI)
W84-05093

PCB UPTAKE AND TRANSFER TO HUMANS BY LAKE TROUT,
Michigan Univ., Ann Arbor. School of Natural Resources.
A. L. Jensen.
Environmental Pollution (Series A), Vol. 34, No. 1, p 73-82, 1984. 5 Fig, 13 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Trout, *Fishing, Mathematical models, Mortality, Lake Michigan, Public health, Foods.

A mathematical model for contaminant uptake from food and water by fishes is combined with a model for yield as a function of fishing mortality in order to examine both the contaminant concentration in fishes and the amount of contaminant transferred to humans from fishes as functions of fishing mortality. The models are fitted to lake trout Salvelinus namaycush data from Lake Michigan, where there has been a persistent problem of PCB contamination. Transfer of contaminants from fishes to humans can be regulated through control of fishing. The concentration of contaminant decreases exponentially as fishing mortality increases because fishing reduces the number of older individuals in the population and concentration is a function of age. The amount of contaminant transferred from a fish population to humans increases to a maximum and then begins to decrease as fishing effort increases. The maximum rate of transfer occurs at a relatively low level of fishing. (Author's abstract)
W84-05094

MAJOR PROCEDURAL DISCREPANCIES IN SOIL EXTRACTED NITRATE LEVELS AND NITROGEN ISOTOPIC VALUES,
Nebraska Univ.-Lincoln. Inst. of Agriculture and Natural Resources.
C. W. Lindau, and R. F. Spalding.
Ground Water, Vol. 22, No 3, May-June, 1984. 4 Fig, 1 Tab, 23 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Vadose water, *Nebraska, Nitrogen, Path of pollutants, Nitrogen radioisotopes, Leaching.

Samples were collected from an area encompassing 144 sq miles of Gage, Saline, and Jefferson counties in southeastern Nebraska. Most of the study area received about 28 inches of precipitation and is composed of flat-lying plains dissected by river and creek valleys. The preliminary data from the five cores indicated that the concentrations of extractable NO3-N and delta-N-15 values are influenced by the volume of extractant (2N KCl). Use of the 1:1 ratio results in underestimating the available NO3-N for leaching through the vadose zone and a probable misinterpretation of the sources of nitrate contamination. More study is needed to determine whether extractable nitrate concentrations and nitrogen isotopic values are influenced by changes in soil properties and by the type of extractant used. It appears logical that samples very high in nitrate necessitate soil-to-extractant (2N CKl) ratios equal to or greater than 1:10, while ratios of 1:5 may be sufficient for samples low in nitrate. (Baker-IVI)
W84-05102

MATRIX DIFFUSION EFFECTS ON CONTAMINANT MIGRATION FROM AN INJECTION WELL IN FRACTURED SANDSTONE,
Golder Associates, Mississauga (Ontario).
S. Feenstra, J. A. Cherry, E. A. Sudicky, and Z. Haq.
Ground Water, Vol. 22, No. 3, p 307-316, May-June, 1984. 8 Fig, 16 Ref.

Descriptors: *Injection wells, *Path of pollutants, *Sandstone, Waste disposal, Mine wastes, Groundwater pollution, Mathematical models.

Deep-well injection into fractured sandstone is an option for the disposal of contaminated mine dewatering discharge from an open pit uranium mine. As part of the assessment of potential contaminant migration from deep well injection, the effect of matrix diffusion was evaluated. The range of effective diffusion coefficients for intact cores of sandstone from boreholes in the vicinity of the proposed injection well studied encompassed samples that exhibited considerable differences in apparent texture and degree of induration. Measured values of the matrix porosity of sandstone samples averaged 9%. An analytical mathematical model was developed for the simulation of the radial movement of contaminants away from an injection point in a single planar fracture with uniform properties. Entry of contaminants into the matrix as a result of diffusion provides a much larger surface area for adsorption than would otherwise be the case in the absence of matrix diffusion. The results of the study are favorable to the concept of short term disposal of contaminated water in the fractured sandstone formation. The main uncertainty in the predictions rests with the inability of the simplified model to account for the spatial variability in both the fracture and matrix properties within the injection zone. (Baker-IVI)
W84-05106

DISTRIBUTION OF NITROGENOUS COMPOUNDS IN A RHODIC PALEUDULT FOLLOWING HEAVY MANURE APPLICATION,
North Carolina State Univ. at Raleigh.
J. R. Cooper, R. B. Reneau, Jr., W. Kroontje, and G. D. Jones.
Journal of Environmental Quality, Vol. 13, No. 2, p 189-193, April-June, 1984. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Manure, *Nitrogen, *Water pollution sources, *Groundwater pollution, Nitrates, Nitrites, Ammonia, Leaching, Fertilizers, Decomposition, Path of pollutants.

Agriculture faces the problem of animal manure disposal while maintaining crop yields and soil water quality. There is an economic advantage of manure disposal at elevated rates close to the source. This in turn increases the potential for groundwater contamination. This study was conducted to determine the effect of high rates of cattle and poultry manure application on the N balance and on the distribution of NH4(+), NO3(-), NO2(-), and total N to a depth of 6 m in a Davidson clay loam soil (Rhodic Paleudult, clayey, kaolinitic, thermic). Average dry weights of manure added per year (from 1972 to 1976) were 32, 61, and 121 Mg/ha for cattle and 94 and 184 Mg/ha for poultry waste. In addition to

manure treatments, a fertilizer treatment and a control were also present. A N balance showed that while 36% of the inorganic fertilizer N applied was removed by the crop, with manure application < 10% of the total was crop recovered. The percentage of the total N in the upper 6 m of the soil profile generally decreased with increased manure N application, although N present increased with increased N applications. The unrecovered N, attributed primarily to denitrification losses, increased with increased N application and ranged from 6% for the fertilizer check to 58% for the highest rate of poultry manure. The primary inorganic N component in the soil profile was NO3(-)-N and the zone of maximum accumulation is between 2 and 2.5 m. The organic N fractions remaining in the soil profile could be adequately estimated using existing decay constants. The present study shows that the most feasible means of determining the quantity of manure to apply for crop growth and simultaneously reduced N leaching would be the use of decay series for manure decomposition combined with an estimate of atmospheric loss. (Author's abstract)
W84-05113

EFFECTS OF FOREST CLEARCUTTING IN NEW ENGLAND ON STREAM CHEMISTRY,
Northeastern Forest Experiment Station, Durham, NH.
C. W. Martin, D. S. Noel, and C. A. Federer.
Journal of Environmental Quality, Vol. 13, No. 2, p 204-210, April-June, 1984. 10 Fig, 1 Tab, 14 Ref.

Descriptors: *Water pollution sources, *Clear-cutting, *Stream pollution, Environmental effects, Watershed management, Forest management, Logging, Nitrogen, Calcium, Water chemistry.

Differences in stream chemistry between recently clearcut and nearby uncut watersheds were generally small in a wide variety of soil and forest types throughout New England. Water samples were collected during six periods of the year in 1978 and 1979 from 6 entirely clearcut, 32 partially clearcut, and 18 uncut watersheds. The largest differences that could be attributed to harvesting occurred in entirely clearcut watersheds, especially in the White Mountains of New Hampshire. In one area of the White Mountains, inorganic N was 4 times higher (2 mg/L), and Ca was 2 times higher (4 mg/L) in streams from a clearcut watershed than in a nearby uncut watershed. Elsewhere, only minor changes in stream chemistry resulted from cutting; the amount of the cutting response was of the same magnitude as natural variations among streams draining similar watersheds. Clearcutting less than entire watersheds, patch and strip cuts, and buffer strips along streams all appear to reduce the magnitude of changes in stream chemistry. (Author's abstract)
W84-05114

POTENTIAL AQUIFER POLLUTION FROM NITRATE LEACHING FOLLOWING THE PLOWING OF TEMPORARY GRASSLAND,
Lincoln Coll. (New Zealand). Dept. of Soil Science.
K. C. Cameron, and A. Wild.
Journal of Environmental Quality, Vol. 13, No. 2, p 274-278, April-June, 1984. 2 Fig, 3 Tab, 14 Ref.

Descriptors: *Nitrates, *Leaching, *Plowing, *Groundwater pollution, *England, Water pollution sources, Grasslands, Soil solution, Mineralization, Chalk soils.

Investigation of the amounts and concentrations of nitrate released following the plowing of temporary grassland confirmed that this practice forms a potential major source of NO3-N pollution of aquifers. Estimates were made of the amounts and concentrations of NO3(-) released due to mineralization following the fall plowing of temporary grassland at three sites on Chalk soils, and the rate of leaching of this NO3-N by winter rainfall. Large amounts of NO3(-) (100 kg N/ha) are released due to fall mineralization and the amount appears to be related to the soil total N content rather than age of the temporary grass. At two sites, losses of NO3(-) due to winter leaching to depths below the 90-cm depth were about 100 kg N/ha over two winters and about 25 kg n/ha over one winter at the third site. High concentrations of NO3(-) in soil solution, in excess of WHO limits, are found to move out of the soil into the unsaturated zones of the Chalk aquifers. The average rate of leaching through the Chalk soils studied in southern England was about 1 m/yr. It is recommended that winter rather than spring cereals be planted after temporary grass and that the crop be planted as soon as possible in order to minimize the leaching loss of NO3(-). (Moore-IVI)
W84-05120

NITRATE LEACHING AS INFLUENCED BY WATER APPLICATION LEVEL AND NITRIFICATION INHIBITORS,
Agricultural Research Service, Ames, IA.
For primary bibliographic entry see Field 5G.
W84-05122

PEAK NITRATE-NITROGEN VALUES IN SURFACE RUNOFF FROM FERTILIZED PASTURES,
Agricultural Research Service, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, W. M. Edwards, and R. W. VanKeuren.
Journal of Environmental Quality, Vol. 13, No. 2, p 310-312, April-June, 1984. 1 Fig, 3 Tab, 13 Ref. EPA grant R-804631.

Descriptors: *Pastures, *Nitrates, *Fertilizers, *Water pollution sources, *Ohio, Grazing, Animal wastes, Agricultural runoff, Surface runoff.

Pastured watersheds on hill slopes in eastern Ohio were fertilized with ammonium nitrate (NH4NO3) at two different levels for 5 years. The pastures were rotationally grazed during either the growing season (May-October) or the dormant season (November-April). Nitrate-N concentrations were measured in surface runoff events > 0.1 mm from nine watersheds. During the 5-year period, there were 890 runoff events. Sixty-four of these events (7%) had NO3-N concentrations > 10 mg/L, and 48 of the 64 events occurred within a 30-day period following fertilizer application. Ten events, < 2% of all of the runoff events, exceeded 30 mg/L NO3-N, and all of these were within 17 day of fertilization. Although all surface runoff events which closely followed fertilizer applications did not have high NO3-N concentrations, all surface runoff with high NO3-N was shortly preceded with a fertilizer application. The closeness of the high NO3-N concentration and fertilizations suggested that fertilizer was the major contributor to high NO3-N in runoff as opposed to animal waste. (Author's abstract)
W84-05123

SIMULATION OF WATER POLLUTION GENERATION AND ABATEMENT ON SUBURBAN WATERSHEDS,
Washington Univ., Seattle. Coll. of Engineering.
B. Glenne.
Water Resources Bulletin, Vol. 20, No. 2, p 211-217, April, 1984. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Watershed management, *Simulation, *Water pollution sources, *Salt Lake City, *Utah, Coliforms, Bacteria, Suspended solids, Water quality control, Assimilative capacity, Computers.

Computer simulation and model calibration of three suburban watersheds near Salt Lake City, Utah, indicate that coliform bacteria and suspended solids are produced mainly by the presence of people, domestic animals, vehicles, disposal systems, and other constructed facilities. The importance of each of these activities is investigated and pollution abatement procedures are outlined for purposes of improved watershed management. Water quality simulation for a watershed integrates several quite approximate methods in hydrology, environmental engineering, and urban planning. Numerical results should be regarded in this light. Of primary interest is the focus provided by the technique on existing cause and effect pollution relationships in the given watershed. In particular, the simulation technique lends itself to mapping of pollution sources and identification of activities which generate stream pollution. By modifying the existing situations in the model the effects of proposed developments or suggested abatement procedures may be roughly anticipated. The technique can also be used to estimate assimilative capacities of watersheds and streams. (Baker-IVI)
W84-05160

TRACE ELEMENTS IN NORTHERN GREAT PLAINS STRIP MINE AND LIVESTOCK IMPOUNDMENT WATER,
Siskiyou National Forest, Grants Pass, OR.
M. T. Anderson, and C. L. Hawkes.
Water Resources Bulletin, Vol. 20, No. 2, p 251-254, April, 1984. 1 Fig, 3 Tab, 20 Ref. EPA grant EPA-IAG-D-5-E764.

Descriptors: *Trace elements, *Strip mines, *Livestock ponds, *North Dakota, *South Dakota, *Wyoming, Coal, Bentonite, Cadmium, Lead, Manganese, Iron, Heavy metals.

The water from 32 strip mine water impoundments and nine livestock watering ponds in North Dakota, South Dakota, and Wyoming were analyzed for trace elements. Because of the high concentrations of trace elements in coal and bentonite clay, the possibility exists for these elements to dissolve or be suspended in the water. Strip mine ponds were not significantly higher in trace elements concentrations compared to livestock ponds. All but one of the 41 ponds sampled contained elemental concentrations that would be detrimental for livestock use or aquatic life use. Cadmium and lead were the elements most frequently in excess of water quality criteria. Lead was found in the study ponds about 35 times the median concentration of North American rivers. Manganese concentrations were found to exceed iron in many ponds, which is unusual in natural waters. The potential for detrimental concentrations of trace elements in pond water must be evaluated when designing land use management plans for ponds intended to be used by livestock or aquatic life. (Author's abstract)
W84-05166

HEAVY METALS IN ESTUARINE SHELLFISH FROM OREGON,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
R. S. Caldwell, and D. R. Buhler.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 15-23, January, 1983. 1 Fig, 6 Tab, 30 Ref. NIH grants ES-00040 and ES-00210, Oregon State Univ. Sea Grant College Program grant 04-3-158-4.

Descriptors: *Shellfish, *Heavy metals, *Oregon, Estuarine environment, Mollusks, Crustaceans, Cadmium, Cockles, Clams, Crab, Seasonal variation, Water pollution sources.

In order to provide a baseline for mean metal concentrations and seasonal variability, concentrations of Hg, Zn, Mn, Fe, Cu, and Cd were determined in marine shellfish from the Oregon coast. Recreationally important shellfish, including cockles, softshell clams and Dungeness crab were collected quarterly in 1972 from estuaries. Additional samples were obtained on an irregular basis in 1970, 1971, and 1974. Other molluscan and crustacean species were collected irregularly during 1971 and 1972. Heavy metal levels in both crustaceans and molluscs were generally typical of those reported from other geographic areas. The primary exception was Cd, which in crustaceans was 5 to 40 times lower and in three of the six marine bivalve molluscs studied was 5 to 25 times lower than that found in most previous studies. The low concentrations of Cd may be due to the lower level and types of industrial activity in coastal Oregon estuaries compared to other regions of the world, and/or to a lower rate of input of this metal from natural weathering processes in this region. No significant variations due either to season or

geographical location were apparent in the three principal shellfish species studied. (Moore-IVI)
W84-05170

LEAD ELIMINATION AND SIZE EFFECTS ON ACCUMULATION BY TWO FRESHWATER GASTROPODS,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
M. C. Newman, and A. W. McIntosh.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 25-29, January, 1983. 2 Fig, 1 Tab, 8 Ref. Contract DE-AC09-76-SR00-H19.

Descriptors: *Gastropods, *Lead, *Fate of pollutants, Elimination, Physiology, Heavy metals, Body size.

Freshwater gastropods, Physa integra and Campeloma decisum, inhabiting a small reservoir with elevated levels of lead displayed widely differing soft tissue lead concentrations. Analysis of environmental factors did not fully explain these differences. Several physiological characteristics of the two gastropods were examined. The influence of snail size on concentrations of naturally-accrued lead was examined as was the rate of lead elimination from the two species. Lead concentrations in P. integra were independent of animal size, while those of C. decisum were described by the curvilinear model: micro g Pb/g dry wt = 2.29(g dry wt)-0.25. Naturally-accrued lead in P. integra was eliminated rapidly during the first four days of clearance but slowly thereafter; a portion of the lead is apparently bound strongly. In contrast, no significant change in lead concentration of gravid or nongravid C. decisum occurred during a three to four week period in which the animals were maintained in a lead-free environment. (Author's abstract)
W84-05171

SYNTHETIC MUSK RESIDUES IN BIOTA AND WATER FROM TAMA RIVER AND TOKYO BAY (JAPAN),
Tokyo Metropolitan Research Lab. of Public Health (Japan). Dept. of Food Hygiene and Nutrition.
T. Yamagishi, T. Miyazaki, S. Horii, and K. Akiyama.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 83-89, January, 1983. 2 Fig, 9 Tab, 13 Ref.

Descriptors: *Musk xylene, *Musk ketone, *Tama River, *Tokyo Bay, *Japan, Wastewater pollution, Shellfish, Fish, Fate of pollutants, Bioaccumulation, Herbicides.

The synthetic musks musk xylene and musk ketone are used in soaps, detergents, creams and lotions as natural musk substitutes. Musk ketone is also used in commercial herbicide formulations. Musk xylene and musk ketone were detected in 100% and 80%, respectively of 74 samples: freshwater fish (three species); marine shellfish (four species); river water, and wastewater (three sewage treatment plants). The samples were collected from several sampling stations along the Tama River, a dam, and Tokyo Bay, during July and October, 1980 and 1981. The average concentrations of musk xylene were 53.9 ppb in the viscera of freshwater fish, 16.0 ppb in the fish muscle, and 2.7 ppb in marine shellfish; the mean levels of musk ketone were 30.5 ppb in the viscera, 7.8 ppb in the muscle, and 1.6 ppb in the shellfish. The mean levels in river water were 4.1 ppt for musk xylene and 9.9 ppt for musk ketone, but no detectable levels of musk ketone were found in freshwater fish and river water upstream of the Tama River and the dam. The highest concentrations of both compounds were observed in freshwater fish downstream, and the highest concentrations in water samples were found in wastewater from the sewage treatment plants, situated along the banks of the river. Both compounds exist as bioaccumulation-type pollutants in the aquatic ecosystem. The contamination by musk xylene and musk ketone was probably due to domestic wastewater. (Moore-IVI)
W84-05174

DISPOSITION OF 2,4-DICHLOROPHENOXYACETIC ACID IN RAINBOW TROUT,
Washington Univ., Seattle. Dept. of Environmental Health.
L. A. Carpenter, and D. L. Eaton.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 169-173, March, 1983. 4 Fig, 1 Tab, 15 Ref.

Descriptors: *Trout, *Dichlorophenoxyacetic acid, Herbicides, Excretion, Fish, Fate of pollutants, Half life.

This study investigated the dynamics of 2,4-dichlorophenoxyacetic acid (2,4-D) in Salmonid fish. Similar to mammals and marine fish, trout excrete 2,4-D via the urine, with an elimination half-life of 2.4 hr. Although the amount of 2,4-D found in bile was always less than 1% of the dose, the concentration of 2,4-D in bile was greater than any other tissue or fluid four hr or more after exposure. From 20 to 96 hr following administration, bile was the only tissue or fluid which contained detectable amounts of 2,4-D. The results demonstrate that rainbow trout eliminate 2,4-D very rapidly via urinary excretion. However, detectable levels of 2,4-D may be found in the bile for many hours after it is eliminated from all other tissues. (Author's abstract)
W84-05179

POLYCHLOROBIPHENYL FLUX IN PLANKTONIC MODEL ECOSYSTEMS,
Canada Centre for Inland Waters, Burlington (Ontario).
E. S. Millard, C. C. Charlton, and G. A. Burnison.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 203-210, March, 1983. 6 Fig, 3 Tab, 15 Ref.

Descriptors: *Polychlorinated biphenyls, *Plankton, *Path of pollutants, Ecosystems, Clay, Particulates, Sedimentation, Organic carbon, Biomass, Volatilization, Algae.

Polychlorobiphenyl (PCB, Aroclor 1242) loadings of 2.12, 21.5 and 212 micro g/d were added to three model planktonic ecosystems. Each loading consisted of a clay and water mixture in which 92% of the PCB was adsorbed to the clay particles. After addition, partitioning between soluble and particulate pools in the water and sedimentation of PCB was examined. Particulate PCB concentrations were positively related to changes in particulate organic carbon (POC) indicating a transfer of PCB from clay to the algal community. The percent of the total PCB concentration measured as soluble was inversely related to POC. The proportion of PCB added to each column that was sedimented, not recovered or remained in the water column was similar at all loading rates. Approximately one-half of the PCB added was not accounted for in sedimentation or the water and was assumed lost by volatilization. High algal biomass and sedimentation of organic matter reduced this loss. (Author's abstract)
W84-05182

NATURE OF CADMIUM BINDING IN COMMERCIAL EASTERN OYSTERS (CRASSOSTREA VIRGINICA),
National Marine Fisheries Service, Charleston, SC. Charleston Lab.
T. C. Siewicki, J. C. Sydlowski, and E. S. Webb.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 3, p 299-304, May, 1983. 4 Fig, 17 Ref.

Descriptors: *Oysters, *Cadmium, *Scallops, Foods, Public health, Zinc, Copper, Metal binding, Metallothionein, Proteins.

The eastern oyster (Crassostrea virginica) is the only mollusk representing a significant food item contributing substantial Cd to the total body burden of consumers. Since the chemical form of ingested Cd may influence its availability or toxicity to the consumer, it is important to determine its form in order to assess its overall risk to human health. The forms of cadmium occurring in 'natural' commercially available oysters were partially characterized. About one-third of the Cd was associated with insoluble material. About 20% of the soluble Cd occurred in a high molecular weight protein of 40,000-50,000 daltons. The low molecular weight soluble Cd consisted of at least two different forms, i.e., that associated with amino acids (a small peptide) and inorganic Cd. The small peptide fraction also contained zinc and copper. The forms of Cd in commercial oysters were compared to those occurring in both commercial scallops and artificially cultured oysters. Scallops bind Cd to three soluble proteins, all of which are of higher molecular weight than the small oyster peptide. Oysters cultured in 10 ppb Cd medium contained binding sites similar to commercial oysters except that none of the soluble Cd in the cultured oysters was associated with a high molecular weight protein. Extremely high environmental Cd levels may be necessary to induce a metallothionein-like protein in oysters. Upon eventual determination of the actual biological availability and toxicity of the various forms of Cd in nature, this data can be used to estimate the potential toxicity of Cd in oysters. (Moore-IVI)
W84-05184

ESTIMATION AND VERIFICATION OF THE ENVIRONMENT FATE OF O-BENZYL-P-CHLOROPHENOL,
Monsanto Co., St. Louis, MO.
A. F. Werner, T. A. Taulli, P. R. Michael, and M. A. Williams.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 4, p 569-575, September, 1983. 4 Fig, 5 Tab, 11 Ref.

Descriptors: *O-Benzyl-p-chlorophenol, *Disinfectants, *Fate of pollutants, Chlorinated phenols, Biodegradation, Municipal wastewater, Wastewater treatment, Bioaccumulation, Photolysis.

O-Benzyl-p-chlorophenol (OBPC) has widespread use in the United States as a hospital phenolic disinfectant; annual production averages less than 4,500,000 kg. Disposal is primarily via municipal waste treatment where biodegradation removes 95% of the OBPC as confirmed by modeling and field measurements. Measured influent and effluent concentrations from 16 sites in the United States averaged 14.8 micro g/L and 0.8 micro g/L, respectively. These measured data confirm the utility of the Holman model (in Aquatic Toxicology and Hazard Assessment: Fourth Conference. ASTM STP 737, 1981) for predicting the concentration of household chemicals during sewage treatment. OBPC is apparently rapidly metabolized by fish and has a low potential to bioconcentrate in biota (bioconcentration factor for OBPC is 75). Based upon laboratory studies, biodegradation and photolysis are the major transformation processes in the environment; hydrolysis and volatilization rates are insignificant. The five percent of the total OBPC reaching the aquatic environment was predicted by two models to partition to the water column resulting in an average surface water concentrations of 0.001-0.008 micro g/L. Environmental sampling at 18 sites in the eastern United States confirmed that the average concentration in surface waters was < 0.11 micro g/L. (Author's abstract)
W84-05191

CHEMICAL AND BIOLOGICAL INDICATORS OF FLUORIDE INPUT IN THE MARINE ENVIRONMENT NEAR AN INDUSTRIAL SOURCE (ARGENTINA),
Aluar Aluminio Argentino, Chubut.
J. O. Ares, A. Villa, and A. M. Gayoso.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 5, p 589-602, September, 1983. 7 Fig, 4 Tab, 48 Ref.

Descriptors: *Smelters, *Aluminum, *Fluorides, *Argentina, Marine environment, Air pollution, Water pollution sources, Diatoms, Wind, Soil erosion, Wind erosion, Precipitation.

Changes in fluoride concentrations in neritic waters near an aluminum smelter in southern Ar-

gentina are attributable to fluoride emissions from industrial operations. Winds from the source vary in importance as pollutant carriers depending on the timing of precipitation events which wet the soil and diminish its erodability. Emissions account for 2 to 6% of the variance of fluoride levels in nearby waters. Some structural changes in the diatom community were detected during these studies, and they were correlated in various ways with fluoride levels. The pattern of these correlations do not support the hypothesis that fluoride changes of the magnitude observed have an effect upon these organisms, but rather than diatoms and fluoride adsorbed on small particles are transported along similar turbulent regimes within neritic waters. The added input of fluoride to the marine environment will probably not alter the balance of this chemical in nearby waters, and the magnitude of the changes observed has not produced changes in the observed planktonic organisms. (Author's abstract)
W84-05192

POLYBROMINATED ANISOLES IN MARINE FISH, SHELLFISH, AND SEDIMENTS IN JAPAN,
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 615-620, November, 1983. 4 Fig, 2 Tab, 11 Ref.

Descriptors: *Polybrominated anisoles, *Fate of pollutants, *Marine environment, *Fish, *Shellfish, *Japan, Marine sediments, Water pollution sources, Dibromoanisole, Tribromoanisole, Pentabromoanisole, Fire retardants, Anisoles, Chlorination, Wastewater treatment.

Polybrominated anisole (2,4-dibromoanisole, 2,4,6-tribromoanisole and pentabromoanisole) concentrations were determined in marine fish, shellfish, and sediments collected in Japan. 2,4,6-Tribromoanisole was found in fourteen of 24 fish and shellfish samples, with a range of 0.1-5.4 micro g/kg (ppb) on a wet weight basis. The concentrations of 2,4,6-tribromoanisole were similar to pentachloroanisole and hexachlorobenzene but about one-hundredth of those of polychlorinated biphenyls. The correlation between 2,4,6-tribromoanisole and polychlorinated biphenyls levels in fish and shellfish samples was statistically significant. 2,4-Dibromoanisole was found in four fish samples, with a range of 0.6-1.3 ppb. Pentabromoanisole was not found in any samples of fish and shellfish. No polybrominated anisoles were detected in the sediment samples. 2,4-Dibromoanisole and 2,4,6-tribromoanisole have not been manufactured for any industrial uses in Japan. The sources of 2,4-dibromoanisole and 2,4,6-tribromoanisole may be the corresponding phenols. Possible sources of 2,4,6-tribromophenol include the chlorination of wastewater and seawater, and the decomposition of flame retardants; 2,4-dibromophenol may be a decomposition product from 2,4,6-tribromophenol. (Moore-IVI)
W84-05193

SEDIMENTARY CHEMISTRY OF A SMALL POLLUTED LAKE, GALLTRASK, S. FINLAND,
Helsinki Univ. (Finland). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W84-05228

TRANSVERSE MIXING IN PHYSICAL MODEL EXPERIMENTS (TURBULENTE QUERVERMISCHUNG IN AUSBREITUNGS-MODELLVERSUCHEN),
Karlsruhe Univ. (Germany, F.R.).
G. Webel, and M. Schatzmann.
Wasserwirtschaft, Vol. 73, No. 5, p 137-142, May, 1983. 6 Fig, 17 Ref.

Descriptors: *Mixing coefficient, *Hydrologic models, *Model studies, *Laboratory models, Path of pollutants, Cooling water, Dispersants, Hydraulic gradient, Parametric hydrology, Waste-assimilative capacity, Wastewater dilution, Wastewater outfall, Assimilative capacity.

After introducing a dimensionless transverse mixing coefficient as similarity criterion for physical modeling of waste-water or cooling-water dispersion in rivers, an experimental study to investigate the dependence of this similarity number on river parameters was carried out. Instructions for setting-up a laboratory dispersion experiments are described. The water should have a 3 cm minimum depth for the model to develop effective results. The mixing coefficient is of the first order in turbulent flow in a stream. (Murphy-IVI)
W84-05240

MIXING PROCESSES PAST OUTFALL DISCHARGES IN STREAMS (AUSBREITUNG BEI EINLEITUNGEN IN STROMUNGEN),
E. Naudascher, and L. Fink.
Wasserwirtschaft, Vol. 73, No. 11, p 369-379, November, 1983. 28 Fig, 25 Ref.

Descriptors: *Discharge hydrographs, *Discharge measurement, *Discharge coefficient, *Flow discharge, Stage-discharge relations, Mixing, Open channels.

Mixing processes near the discharge area and downstream are illustrated through numerical and graphical analysis. The experiments were carried out both in water and air tunnels. Their goal was to expand our knowledge on turbulent dispersion phenomena and to yield a basis for the development of computational methods. In particular, the effect of outfall-discharge and mainstream parameters were investigated for round coaxial and transverse jets, for jets with swirl and pulsation, as well as for lateral discharges into open channels. Application of the results is illustrated with selected examples. (Murphy-IVI)
W84-05255

NUMERICAL CALCULATION OF TURBULENT TRANSPORT PROCESSES IN WATER BODIES (NUMERISCHE BERECHNUNG TURBULENTER AUSBREITUNGSBORGANGE IN GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
W. Rodi.
Wasserwirtschaft, Vol. 73, No. 11, p 401-410, November, 1983. 14 Fig, 26 Ref.

Descriptors: *Mathematical models, *Turbulent flow, *Flow characteristics, Differential equations, Mathematical analysis.

The development at the SFB 80 of field methods for the numerical calculation of turbulent transport processes in water bodies is summarized. The methods are based on the differential equations describing the flow and pollutant concentration field and simulate the turbulent exchange processes with the aid of various versions of the fairly universal k-(epsilon) turbulence model. Computational efficiency is achieved by employing the model chain concept, which subdivides the total solution domain into individual regimes for which the simplest possible model component is used. The wide applicability of the methods is demonstrated by a number of calculation examples. (Murphy-IVI)
W84-05257

INTEGRAL MODELS FOR BUOYANT PLUME CALCULATIONS (INTEGRALVERFAHREN ZUR BERECHUNG VON AUFTRIEBSSTRAHLEN),
Hamburg Univ. (Germany, F.R.). Meteorology Inst.
M. Schatzmann.
Wasserwirtschaft, Vol. 73, No. 11, p 416-422, November, 1983. 12 Fig, 20 Ref.

Descriptors: *Integral models, *Plumes, *Model studies, *Flow characteristics, Jets, Wastewater disposal, Cooling water, Diffusion coefficient, Discharge coefficient, Discharge hydrographs.

Integral models have been proven to be successful and inexpensive tools for the solution of a variety of jet-type environmental flow problems. In the Sonderforschungsbereich 80, a family of integral models have been developed for several applications as, e.g., the mixing of waste water and cooling water plumes discharged into lakes and coastal waters or the dispersion of pollutants and heat emitted by chimneys, cooling towers and urban heat islands into the atmosphere. The common features of these integral models are discussed. The quality of the model results is demonstrated by comparing predictions with experimental data. (Murphy-IVI)
W84-05258

BIOLOGICAL REACTIONS IN WATERS (BIOLOGISCHE REAKTIONEN IN GEWASSERN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Ingenieurbiologie.
For primary bibliographic entry see Field 2H.
W84-05261

SHELL OF MYTILUS AS AN INDICATOR OF ZONAL VARIATIONS OF WATER QUALITY WITHIN AN ESTUARY,
Dundee Univ. (Scotland). Dept. of Geology.
M. A. M. Al-Dabbas, F. H. Hubbard, and J. McManus.
Estuarine, Coastal and Shelf Science, Vol. 18, No. 3, p 263-270, March, 1984. 1 Fig, 4 Tab, 25 Ref.

Descriptors: *Mytilus, *Shells, *Bioindicator, *Estuaries, *Water quality, Mineralogy, Chemical properties, Tay estuary, Aragonite, Bioaccumulation, Monitoring, Copper, Pollutant identification.

The mineralogy and chemistry of the shell material secreted by organisms can vary with the environment of growth. Variations in the mineralogy and chemistry of the shells of the filter-feeding organism Mytilus edulis have allowed discrimination of subenvironments of growth within the Tay estuary. Aragonite proportions higher than those predictable for the temperature, tidal, growth conditions are associated with stretches of the estuary affected by organic pollution. Accumulation and concentration of copper (Cu) in the organic periostracum suggest that Mytilus shell may also prove useful as a monitor of metallic element pollution. The relatively fragile nature of the polylayer shell of Mytilus and the layer specific distribution of components require the use of either complete, undamaged specimens or population groups to discriminate significant variations. (Murphy-IVI)
W84-05288

5C. Effects Of Pollution

ENVIRONMENTAL IMPACT OF NITRATE DISTRIBUTIONS IN THE LAKE-EFFLUENT CANAL SYSTEM IN KANDY, SRI LANKA,
Sri Lanka Univ., Peradeniya. Dept. of Geology.
S. V. R. Weerasooriya, A. Senaratne, and C. B. Dissanayake.
Journal of Environmental Management, Vol. 15, No. 3, p 239-250, October, 1982. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Environmental impact statement, *Nitrate, *Kandy, *Sri Lanka, Domestic wastes, Nitrification, Ions, Ammonium, Water quality, Water pollution effects, Water pollution.

Even though pollution from industrial effluents has not yet caused serious concern in Sri Lanka, pollution of ground water and drinking well water from biological sources has reached significantly high proportions during the last decade. The mid-canal of Kandy, Sri Lanka (an effluent canal running through the city and a large residential area) has been studied for its content of nitrogenous matter and its environmental impact on the surrounding residential area. The canal itself carries a very large load of nitrogenous waste matter, mainly from human and animal excreta. In spite of this, the NO3(-)-N and NH4(+)-N levels were low, indicating the existence of nitrogen in other forms. Water from wells situated near to the canal had higher concentrations of NO3(-)-N, indicating the possibility of nitrification and migration of the newly formed NO3(-)-N through the permeable alluvium. Because the potential for nitrification has

ot been fully realized, and because a large number f families use these wells for washing, bathing, ooking, and in some cases for drinking, a serious ealth hazard can be envisaged in the future. Murphy-IVI)
V84-04817

LONGEVITY OF ALGAL INHIBITION AFTER CHLORINATION OF ESTUARINE WATER,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 2L.
W84-04891

BEHAVIORAL RESPONSES OF A PHOXOCEPHALID AMPHIPOD TO ORGANIC ENRICHMENT AND TRACE METALS IN SEDIMENT,
Moss Landing Marine Labs., CA.
J. M. Oakden, J. S. Oliver, and A. R. Flegal.
Marine Ecology - Progress Series, Vol. 14, No. 2 and 3, p 253-257, January, 1984. 5 Tab, 24 Ref. EPA grant 808772-01.

Descriptors: *Behavior, *Phoxocephalid amphipod, *Trace metals, *Organic loading, Sediment composition, Food habits, Water pollution effects, Organic enrichment.

Marine bottom communities around large waste discharges often are highly modified, and characterized by the absence of certain groups of benthic invertebrates, particularly crustaceans and echinoderms. Phoxocephalid amphipods, Rhepoxynius spp., avoided sediments mixed with domestic sewage, or with concentrations of trace metals (zinc and cadmium) which are characteristic of marine sediments at waste-water discharge sites. The amphipods burrowed and swam from fine sands enriched with 15% sewage, and from sewage-contaminated sediment collected near the White's Point outfall in southern California, USA. They also suffered high (> 50%) mortality in sediment inoculated with high levels of zinc (610 micro g/g) or cadmium (190 micro g/g); swam and burrowed from sediments with high and moderate concentrations of either element; and burrowed from sediments with relatively low concentrations of either element. These responses indicate that behavioral avoidance of contaminated sediment may be important in maintaining population patterns of these phoxocephalids, which are often rare or conspicuously absent around large waste discharges. (Murphy-IVI)
W84-04901

THERMAL TOLERANCE IN EMBRYOS AND LARVAE OF THE BAY SCALLOP ARGOPECTEN IRRADIANS UNDER SIMULATED POWER PLANT ENTRAINMENT CONDITIONS,
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
D. A. Wright, W. H. Roosenburg, and M. Castagna.
Marine Ecology - Progress Series, Vol. 14, No. 2 and 3, p 269-273, January, 1984. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Thermal pollution, *Ecological effects, *Thermal tolerance, *Embryos, *Larvae, *Bay scallop, *Simulation, Cooling water, Lethal limit, Simulation analysis, Mortality.

Increasing demand for electricity has prompted the consideration of estuarine and marine coastal sites for both fossil fuel and nuclear power plants. This in turn has led to concern over the effects on marine and estuarine animals of heated water discharged from the condenser tubes and of heat exposure to entrained larvae. Thermal tolerance was tested in cleavage stages, trochophores and straight hinge larvae of the bay scallop Argopecten irradians. Experiments were designed to simulate larval entrainment in power plant cooling systems. An 11 (temperature) x 8 (time) matrix was used with temperatures ranging from 20.6 to 43.0 degrees C and exposure times from 1 min to 6 h. Pooled mortality data from triplicate experiments for each larval stage were subjected to stepwise regression analysis. Equations derived from these analyses, comprising first, second and third order terms for temperature and time, were used to generate response surfaces relating mortality to temperature and exposure time. In general, higher mortalities were associated with higher temperatures and with longer time exposure at any one temperature. However, there was some evidence of cold shock in trochophore and straight hinge larvae, with elevated mortalities occurring at temperatures lower than the spawning temperature. There was a trend towards increased thermal tolerance in older larvae, although in general A. irradians showed the greatest sensitivity to thermal shock of the estuarine bivalves so far tested in our laboratory. (Murphy-IVI)
W84-04902

DEVELOPMENT OF THE PHYTOPLANKTON AND PHYTOBENTHOS UNDER THE INFLUENCE OF WASTE WATERS (DIE ENTWICKLUNG DES PHYTOPLANKTONS UND DES PHYTOBENTHOS UNTER DEM EINFLUSS DER ABWASSER),
Osijek Univ. (Yugoslavia).
D. Gucunski.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 216-229, 1982. 15 Ref.

Descriptors: *Phytoplankton, *Phytobenthos, *Water pollution effects, *Wastewater, Behavior, Self-purification, Danube River, Aquatic productivity, Hydrobiology, Bacillariophyceae.

In the communities of phytoplankton and phytobenthos of all the profiles studied in the river basin of the Danube which was under the influence of waste waters, the bacillariophyceae dominated at all seasons. The species Stephenodiscus hantzschii Grun. (alphamesosaprobic indicator) was present in the plankton communities of all the profiles. Based on the available vegetal indicators, it was established that the investigated stretches of the Danube and its tributaries are, as a whole, part of the betamesosaprophytic zone. Comparison of the results of the hydrobiological investigations pursued over a length of years has shown that the phytoplankton production has increased over the last decades due to the eutrophication of the Danube. In all of the profiles examined, self-purification processes have taken place in which the microphytes and macrophytes played an important role. There where waste water purification plants are already operating, the water quality gradually improves; this, on the whole, has a positive effect on the development of the primary producers and on the biocenosis. It is our opinion that, in order to efficiently protect the ecosystem of the Danube and its tributaries, it will be necessary in the future to intensify the hydrobiological investigations which should be coordinated at the international level. (Murphy-IVI)
W84-04910

DEVELOPMENT OF THE ZOOPLANKTON AND ZOOBENTHOS UNDER THE INFLUENCE OF WASTE WATERS (DIE ENTWICKLUNG DES ZOOPLANKTONS UND - BENTHOS UNTER DEM EINFLUSS DES ABWASSERS),
Magyar Tudomanyos Akademia, Budapest. Station for Danube Research.
A. Bothar.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 230-242, 1982. 17 Ref.

Descriptors: *Water pollution effects, *Zooplankton, *Zoobenthos, Danube, Biological properties, Ecological effects, Self-purification, Reviews.

Based on sixteen short papers presented by experts from Rumania, Yugoslavia and Hungary, the author reports on the effects of waste waters on the zooplankton and zoobenthos of the Danube and its tributaries. The numerous themes treated in the papers are grouped according to the type of pollution and the various stages of organization. In the coming years, the Danube and its larger tributaries will be able to cope with the pollution thanks to their self-purifying capacity. The tributaries possessing a lesser self-purifying capacity will, owing to their shorter length and their weaker stability, react more sensitivity to pollution, so that their water quality will deteriorate in a higher degree; thus, they will become increasingly dangerous for the Danube. The side-arms and the dead-arms functionally form a unity with the Danube. Their pollution brings irreversible changes in the Danube which are then reinforced by the impounding reservoirs, especially due to the increase of the retention time of the water. (Murphy-IVI)
W84-04911

ANTHROPOGENIC EFFECTS ON THE FISH POPULATION (ANTHROPOGENE EINWIRKUNGEN AUF FISCHBESTANDE),
Galati Univ. (Romania).
N. Bacalbasa-Dobrovici.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 243-251, 1982. 7 Ref.

Descriptors: *Anthropogenic effects, *Fish, *Population dynamics, Population density, Ecological effects, Fish populations, Danube River, Chub, Perch, Pike, Population exposure, Pollution load.

In the last two decades, anthropogenic effects on fish have become more and more perceptible. Growth of some species, hematological characteristics, changes in the fish populations, and adaptation of fishery methods have been studied. The satisfying development of the bleak in the central zone of the Danube has continued; the greatest increase was observed during the first two years of their life. Warm water seems to be beneficial to their growth. The extremely large population can also be attributed to the very limited fishery. When the water is polluted, many young, unripe, red corpuscles were found in the genera Barbus and Leuciscus. In the upper basin of the Danube, many of the fish populating the inland water bodies were infested by the tape-worm genus Proteocephalus; the loss of weight was at least 20%. The reduction of the barbel catches during the last twelve years is found over the whole Hungarian part of the Danube; it is a consequence of pollution from the upper basin of this river. The histological analyses show that the gonads of bleak and chub attain maturity earlier and more quickly in the warmer parts of the Velika Morava than in the other parts of the river. In the impounding lakes Mostistea and Rasa built in the south of the Baragan plain for irrigation purposes, bream and perch-pike have become the main species; carp are regressing. Owing to the relative great depth of 7 m, the fishery has had to adapt to a difficult technique. (Murphy-IVI)
W84-04912

BIOLOGICAL AND BIOCHEMICAL CONTRIBUTIONS OF DETERMINATION AND EVALUATION OF WATER QUALITY (BIOLOGISCHE UND BIOCHEMISCHE BEITRAGE ZUR ERFASSUNG UND BEWERTUNG DER GEWASSERGUTE),
Forschungsinstitut fuer Wasserwirtschaft, Bratislava (Czechoslovakia).
J. Ardo.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 252-262, 1982. 16 Ref.

Descriptors: *Bioindicators, *Biochemistry, *Water quality, Danube River, Water pollution effects, Macrophytes, Plankton, Reviews.

Four themes are dealt with in the present review. For the assessment of water quality, the macrophytes (as an indicator of the degree of pollution) and ATP concentration (for quantification of the bacterial biomass) prove to be favorable methods. The influence of sewage on surface waters is exemplified as the influence of urban and industrial wastes upon the algal biomass assay (Biomassentiter), the microbial colonization, the complete biocenosis and the toxicological effects which ensue. As illustrations to the change of water quality along the river course, the nitrification's-oxygen-demand's share of the BSB5-total value and the periphyton biomass is given. In a further topic, information from the following areas are summarized: studies of the water quality in the Bavarian Danube, ciliate and crustacean communities in the

Hungarian Danube and the influence of its tributaries and the saprobial plankton community in the Rumanian Danube in addition to the statistical evaluation of water quality in this section. (Author's abstract)
W84-04913

ASSESSING THE EFFECTS OF WATER CONTAMINATION,
Johns Hopkins Univ., Baltimore, MD.
A. Wolman.
Civil Engineering, Vol. 54, No. 4, p 38-41, April, 1984. 2 Fig.

Descriptors: *Water supply, *Drinking water, *Water pollution effects, Water pollution control, Public health, Organic compounds, Water treatment, Human diseases, Wastewater treatment.

Findings of ill effects in humans who have used water contaminated with microbiological producers of infectious diseases or with inorganic chemicals are documented. Similar reports for waters contaminated with organic chemicals are much less exacting. However, there are certain policies for future preventative and remedial measures for the management of wastewaters and the protection of drinking water which become obvious from reviews of the results of exposure to impure waters. The recording of waterborne infectious diseases has a long history with typhoid, dysentery, cholera, and amoebic dysentery. Evidence is still accumulating that nitrates and nitrites may create ill human effects. Throughout the increased production of organic chemicals the demand for removing the organic residues from drinking water grew. Testing of all organics increased so as to determine whether they were harmful for human consumption. Even so, the significance of their health effects when present in drinking water has not been clearly identified in the last 10 years of legislative or regulatory debate. Among the technologies available to treat the water are air stripping and use of carbon columns to remove the impurities. Ideally, chemical processes should approach closed cycles as much as possible. (Baker-IVI)
W84-04923

MERCURY CONTAMINATION OF THE BELGIAN AVIFAUNA 1970-1981,
Vrije Univ., Brussels (Belgium). Lab. foor Ecotoxicologie.
K. Delbeke, C. Joiris, and G. Decadt.
Environmental Pollution (Series B), Vol. 7, No. 3, p 205-221, 1984. 2 Fig, 6 Tab, 32 Ref.

Descriptors: *Mercury, *Contamination, *Aquatic birds, Food habits, Diets, Water pollution effects, Toxicity, Bioaccumulation, Biomagnification, Fate of pollutants.

Two hundred birds found dead in Belgium between 1970 and 1981, and belonging to 30 species, were analyzed for total mercury contamination. The contamination of aquatic birds ranged between 0.11 and 35 micro g/g wet weight. For terrestrial birds, the extreme values were: not detectable and 14 micro g/g. In both cases, differences in diet can explain the differences in contamination. The order of diets associated with increasing mercury contamination for aquatic birds was invertebrates, zooplankton and garbage, and fish; and for terrestrial birds this consisted of plants, invertebrates, mammals and birds. For raptors and owls, this effect of diet includes geographical variations within species. A higher mercury contamination level in the winter and early spring was noted for two species of owls. For aquatic birds, the contamination of liver was higher than that of kidney, with ratios varying between 1.2 and 2.5. For terrestrial birds, the ratio was closer to 1. A few determinations were also made for muscle and heart, giving respectively 0.25 and 0.6 of the liver contamination. Among the birds analyzed for their liver contamination, 15% showed levels higher than 3 micro g/g and could have been affected in their reproduction; 3% had levels higher than 10 micro g/g, and could have died from mercury poisoning; and 6% showed an abnormally high liver:kidney ratio, which could reflect an acute intoxication. There exists a striking parallelism between the levels of mercury and of organochlorine residues (DDT) in birds of prey, suggesting the existence of common ecotoxicological mechanisms. (Author's abstract)
W84-04942

THERMAL AND METABOLIC FACTORS AFFECTING PCB UPTAKE BY ADULT BROWN TROUT,
Argonne National Lab., IL. Radiological and Environmental Research Div.
S. A. Spigarelli, M. M. Thommes, and W. Prepejchal.
Environmental Science and Technology, Vol. 17, No. 2, p 88-94, February, 1983. 4 Fig, 3 Tab, 31 Ref.

Descriptors: *Polyclorinated biphenyls, *Thermal stress, *Metabolism, *Brown trout, Bioaccumulation, Toxicity, Food habits, Diets, Water pollution effects, Fish behavior.

The accumulation of PCBs from natural food and water by adult brown trout, Salmo trutta, were compared under three temperature treatments: a diel temperature cycle simulating that selected by brown trout in thermal effluents; a constant 13 degrees C, the optimum constant temperature for brown trout growth; natural fluctuations in ambient inshore temperatures. Direct uptake from water accounted for approximately 10% of the uptake from food and water. Fish exposed to the diel cycle or the arhythmic ambient regime fed and grew as though they were acclimated to the maximum temperatures experienced and accumulated more PCBs than fish exposed to the constant 13 degrees C regime. Total food consumption or growth was the best correlate of PCB concentration in whole fish while lipid content of muscle was the best correlate of PCB concentration in muscle. PCB accumulation was affected by temperature magnitude and variation, because these factors controlled food consumption, growth and lipid content of brown trout. (Author's abstract)
W84-04944

EFFECTS OF ACID RAIN ON APPLE TREE PRODUCTIVITY AND FRUIT QUALITY,
New York State Agricultural Experiment Station, Geneva.
P. L. Forsline, R. C. Mussleman, W. J. Kender, and R. J. Dee.
Journal of the American Society of Horticultural Science, Vol. 108, No. 1, p 7-74, 1983. 1 Fig, 5 Tab, 29 Ref.

Descriptors: *Apples, *Acid rain, *Crop yield, Hydrogen ion concentration, Russetting, Simulation.

Mature 'McIntosh', 'Empire', and 'Golden Delicious' apple trees (Malus domestica Borkh.) were sprayed with simulated acid rain solutions in the pH range of 2.5 to 5.5 at full bloom in 1980 and in 1981. In 1981, weekly sprays were applied at pH 2.75 and pH 3.25. Necrotic lesions developed on apple petals at pH 2.5 with slight injury appearing at pH 3.0 and pH 3.5. Apple foliage had no acid rain lesions at any of the pH levels tested. Pollen germination was reduced at pH 2.5 in 'Empire'. Slight fruit set reduction at pH 2.5 was observed in 'McIntosh'. The incidence of russetting on 'Golden Delicious' fruits was ameliorated by the presence of rain-exclusion chambers but was not affected by acid rain. With season-long sprays at pH 2.75, there was a slight delay in maturity and lower weight of 'McIntosh' apples. Even at the lowest pH levels no detrimental effects of simulated acid rain were found on apple tree productivity and fruit quality when measured as fruit set, seed number per fruit, and fruit size and appearance. (Author's abstract)
W84-05068

OBSERVATIONS ON THE FISH POPULATIONS OF AN EAST COAST ESTUARY,
Southern Water Authority, Chatham (England). Kent Div.
J. R. Wharfe, S. R. Wilson, and R. A. Dines.
Marine Pollution Bulletin, Vol. 15, No. 4, p 133-136, April, 1984. 4 Fig, 11 Ref.

Descriptors: *Fish, *Estuaries, *Medway Estuary, *England, Seasonal distribution, Species diversity, Herring, Smelt, Water quality, Thames, Tidal effects.

The technique of sampling fish from power station cooling water intake screens has been used during a previous study of the Medway Estuary (England). Monthly samples were again collected from the cooling-water intake screens at Kingsnorth Power Station on the Medway Estuary between April 1981 and August 1983. A total of 26,372 fish comprising 41 species, was recorded. The seasonal distribution of both species numbers and abundance of fish was similar to earlier studies. The community structure has altered in recent years with the more frequent occurrence and increasing population size of smelt and herring. The change is largely attributed to improved water quality conditions in the tidal Thames and the subsequent recolonization by species of fish which were previously absent for many years. The confluence of the tidal Medway and the Thames Estuary ensures a flood tide common to both systems. (Moore-IVI)
W84-05079

INFLUENCE OF TURBID INFLOWS ON VERTICAL DISTRIBUTION OF LARVAL SHAD AND FRESHWATER DRUM,
Oklahoma Univ., Kingston. Biological Station.
W. J. Matthews.
Transactions of the American Fisheries Society, Vol. 113, No. 2, p 192-198, March, 1984. 2 Fig, 3 Ref. Fish and Wildlife Service contracts 14-16-0009-81-023 and 14-16-0009-82-018.

Descriptors: *Fish behavior, *Drum, *Shad, *Larval growth stages, *Turbidity, *Lake Texoma, Zooplankton, Fish food, Reservoirs, Depth distribution, Population dynamics.

Reservoirs on river mainstreams are subject to periodic floods that typically increase turbidity. Lake Texoma (Oklahoma-Texas) is a 36,000 ha impoundment of the Red and Washita rivers. In many years, the reservoir receives floods near or during the spawning seasons for fishes. These inflows rapidly raise the water level as much as several meters and introduce highly turbid water from trubutaries. Behavior of larval shad Dorosoma spp. and freshwater drum Aplodinotus grunniens was altered by inflow of turbid water into Lake Texoma in two different years. During periods of increased turbidity, larval shad were concentrated in a reduced volume of water near the surface, and larval freshwater drum were distributed throughout the water column in contrast to their normal concentration near the bottom. In 1981 and 1982, greatest decline in abundance of larval shad came after zooplankton density fell below 100 per liter, and during or immediately following an extended period of high turbidity. Nutritional stress resulting from decline in zooplankton abundance and changes in larval-fish behavior during turbid conditions could be one important factor in population dynamics of shad in reservoirs. (Moore-IVI)
W84-05085

CONSEQUENCES OF OIL POLLUTION ON THE DECOMPOSITION OF VASCULAR PLANT LITTER IN FRESHWATER LAKES: PART 1- DECOMPOSITION RATES AND DISSOLVED OXYGEN UTILISATION,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
M. D. Werner, V. D. Adams, and V. A. Lamarra.
Environmental Pollution (Series A), Vol. 34, No. 1, p 83-100, 1984. 2 Fig, 8 Tab, 26 Ref. OWRT project B-187-Utah.

Descriptors: *Oil pollution, *Decomposition, *Dissolved oxygen, Aquatic plants, Biological oxygen demand, Wind, Oxidation, Litter.

The effects of two crude oils on the decomposition of two aquatic macrophytes within two oligotrophic lakes located in the Rocky Mountains of the Western United States were studied. Additionally, the biological oxygen demand placed on the lakes

due to crude oil was assessed. During the year of investigation, the crude oils reduced the rate and extent of litter decomposition of the plant litter in both lakes. However, the metabolic activity of the oil-exposed decomposer community was greater than, or equal to, that of unoiled controls. Differences in the degree of impact of oils between plant types and lakes are explained by factors such as the biochemical structure of the plants, the sediment type of the lakes and the degree of physical energy input (e.g. wind) to the lakes. Up to 4.8 times as much oxygen was required to oxidize oiled plant matter as that required to oxidize the same unoiled plant litter. (Author's abstract)
W84-05095

UPTAKE AND PHOTOSYNTHETIC INHIBITION BY ATRAZINE AND ITS DEGRADATION PRODUCTS ON FOUR SPECIES OF SUBMERGED VASCULAR PLANTS,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
T. W. Jones, and L. Winchell.
Journal of Environmental Quality, Vol. 13, No. 2, p 243-247, April-June, 1984. 4 Fig, 3 Tab, 18 Ref.

Descriptors: *Atrazine, *Submerged plants, *Phytotoxicity, *Chesapeake Bay, Herbicides, Photosynthesis, Estuaries, Potamogeton, Ruppia, Myriophyllum, Zannichellia, Water pollution effects, Macrophytes.

The photosynthetic inhibitory effect of atrazine (2-chloro-4-ethyl-amino-6-isopropyl amino-1,3,5-triazine) and three of its major metabolites (deethylated, deisopropylated, and hydroxyatrazine) were determined for four species of submerged macrophytes: Potamogeton perfoliatus L., Ruppia maritima L., Myriophyllum spicatum L., and Zannichellia palustris L. The four species showed a similar response to varied dosages of the parent atrazine compound with an average I1 (concentration at which photosynthesis is inhibited by 1%) for the four species of 20 micro g/L and an average I50 (concentration at which photosynthesis is inhibited by 50%) for the four species of 95 micro g/L. The three major degradation metabolites of atrazine produced varying degrees of photosynthetic inhibition in the four species, but generally the order of toxicity was deethylated > deisopropylated > hydroxyatrazine with hydroxyatrazine causing an apparent stimulation of photosynthesis in several species. Of four species tested, Myriophyllum spicatum L. was the most resistant to atrazine and its metabolites. The magnitude of the actual uptake of the compounds (micro g compound/grams dry wt (gdw) plant) by the plants correlated closely with the photosynthetic inhibitory response, i.e., at the same concentration the uptake of atrazine > deethylated > deisopropylated > hydroxyatrazine. Considering that an extremely high environmental concentration (0.5 mg/L) of deethylated atrazine for an estuary only produced a photosynthetic inhibition of from 20 to 40% in four major species of submerged macrophytes, it is concluded that the degradation products of atrazine tested did not play a major role in the disappearance of the submerged vascular plants from the Chesapeake Bay. (Author's abstract)
W84-05118

PERCEIVED WATER QUALITY AND THE VALUE OF SEASONAL HOMES,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
C. E. Young.
Water Resources Bulletin, Vol. 20, No. 2, p 163-166, April, 1984. 1 Tab, 9 Ref.

Descriptors: *Water pollution effects, *Property value, *St Albans Bay, *Vermont, *Lake Champaign, Water quality,.

St. Albans Bay is a large bay on Lake Champaign in northern Vermont. Recreational use of the bay has declined over time. A major reason for this decline is the deterioration in water quality. The impact of degraded water quality on the value of seasonal homes adjacent to St. Albans Bay is estimated using hedonic price functions. The value of properties located adjacent to the bay are depressed by about 20%, or $4,500 on average, compared with similar nearby properties on the larger but cleaner lake. Approximately 430 residential properties are located adjacent to St. Albans Bay. If the quality of water in the Bay were improved to a level perceived to be equivalent to the main lake, the total value of properties adjacent to the Bay would increase by about two million dollars. If the perceived improvement were only 50%, the water quality rating variable can be used to estimate the impact on property values. For a perceived improvement of 50%, the increase in property values would be $903,000. (Baker-IVI)
W84-05153

BEHAVIORAL RESPONSES TO TWO ESTUARINE FISH SPECIES SUBJECTED TO BIS (TRI-N-BUTYLTIN) OXIDE,
Johns Hopkins Univ., Shady Side, MD Aquatic Ecology Section.
L. W. Hall, Jr., A. E. Pinkney, S. Zeger, D. T. Burton, and M. J. Lenkevich.
Water Resources Bulletin, Vol. 20, No. 2, p 235-239, April, 1984. 2 Fig, 17 Ref.

Descriptors: *Fish behavior, *Bis (tri-n-butyltin) oxide, Bass, Menhaden, Organotin compounds, Avoidance, Antifouling paints, Estuarine fish, Toxicity.

The objective of this investigation was to evaluate the avoidance responses of juvenile striped bass, Morone saxatilis and Atlantic menhaden, Brevoortia tyrannus to bis (tri-n-butyltin) oxide. An avoidance responses was exhibited by striped bass at a total organic tin concentration of 24.9 micro g/L. Atlantic menhaden exhibited avoidance to total organic tin concentrations of 5.5 micro g/L and greater. Atlantic menhaden are generally more sensitive to toxicants than striped bass; therefore, avoidance responses reported in this study are not surprising. It is highly likely that the concentrations of total organic tin that were avoided by the test species in this study were much higher than expected environmental concentrations. Ecologically significant hazards may occur due to potential effects that unperceived or non-avoided organotin concentrations may have on behavioral responses mediated by chemosensory systems. (Author's abstract)
W84-05164

EFFECTS OF CADMIUM ON YOLK UTILIZATION, GROWTH, AND SURVIVAL OF ATLANTIC SALMON ALEVINS AND NEWLY FEEDING FRY,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
R. H. Peterson, J. L. Metcalfe, and S. Ray.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 37-44, January, 1983. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Cadmium, *Toxicity, *Salmon, Growth, Immature growth stages, Alevins, Fry, Mortality, Water pollution effects.

Growth and the yolk-to-embryo gross conversion efficiencies were determined for Atlantic salmon (Salmo salar L.) alevins and fry reared under control conditions and at 0.2 and 2.0 ppb cadmium (Cd). Alevins reared at 2.0 ppb Cd grew more slowly than controls and alevins reared at 0.2 ppb. The size reduction was due primarily to reduction in yolk-conversion efficiency during the latter half of yolk absorption. The rate of yolk uptake was also reduced at 2.0 ppb Cd. Mortality of feeding fry reared up to one month at 2.0 ppb Cd was 80 to 90%. Fry previously reared in 2.0 ppb Cd as alevins experienced lower mortality than those introduced to Cd at start of feeding. Mortality was preceded by hyperactivity and convulsions; 30 to 60% of fry exposed to 2.0 ppb Cd developed cranial swellings. Growth of fry surviving 2.0 ppb Cd for one month was severely retarded. There were no adverse effects from 0.2 ppb Cd. (Author's abstract)
W84-05172

HUMAN ENVIRONMENTAL EXPOSURE TO TRICHLORO- AND TETRACHLOROETHYLENE FROM WATER AND AIR IN MILAN, ITALY,
Milan Univ. (Italy). Inst. of Hygiene.
G. Ziglio, G. M. Fara, G. Beltramelli, and F. Pregliasco.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 1, p 57-64, January, 1983. 12 Tab, 28 Ref.

Descriptors: *Trichloroethylene, *Tetrachloroethylene, *Drinking water, *Human, *Milan, *Italy, Air pollution, Municipal water, Chlorinated hydrocarbons, Groundwater pollution, Trichloroacetic acid.

Annual consumption of trichloro- (TRI) and tetrachloroethylene (PER) in the Milan city area is estimated to be between 1,500 and 2,000 tons. Improper use and disposal of TRI and PER for many years have led to a serious pollution of groundwater, which is used untreated by 1,750,000 inhabitants through the municipal aqueduct. Two separate sub-areas of the city were considered, namely zone A (TRI and PER concentrations: 80 and 20 micro g/L, respectively) and zone B (12 and 4 micro g/L). Trento, a 70,000 inhabitants towns of northern Italy, supplied with drinking water not contaminated with TRI and PER, was chosen as a control (zone C). Atmospheric levels of TRI and PER were also measured: TRI concentrations were similar in zones A and B (7.6 and 7.1 mg/cu m), but higher levels of PER were found in zone A (14.8 vs 9.5 micro g/cu m), where many dry-cleaning laundries are located. In human subjects from the three zones, the total exposure to TRI and PER was biologically evaluated by measuring the plasmatic level of their metabolite trichloroacetic acid (TCA). Median plasmatic TCA levels were 38.2 micro g/L in zone A, 19.0 in zone B and only 7.5 in the control zone. The observed differences were highly significant, and unrelated to sex, age, body weight, residence, and the amount of water consumption. (Author's abstract)
W84-05173

HEMATOLOGICAL DYSCRASIA IN TELEOSTS CHRONICALLY EXPOSED TO SELENIUM-LADEN EFFLUENT,
Texas Univ. at Austin. Dept. of Pharmacology.
E. M. B. Sorensen, and T. L. Bauer.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 135-141, March, 1983. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Sunfish, *Water pollution effects, *Selenium, *Texas, *Martin Lake, Toxicity, Effluents, Powerplants, Industrial wastewater, Hepatopancreas, Blood disorders, Fly ash, Sludge, Bottom ash, Lepomis.

Lepomis microlophus (redear sunfish) were collected from Martin Lake, an east Texas reservoir, as well as a reference lake 8 km upstream in the same drainage system. Martin Lake received aqueous selenium-laden effluent from electrical generator plant systems used to collect fly ash, scrubber sludge, and bottom ash; the reference lake received no such effluent (Texas Parks and Wildlife Department, unpublished report). Neutron activation analysis was used to monitor selenium levels in the hepatopancreas (i.e., the liver and associated, disseminated exocrine pancreas), which is one of the major organs used in monitoring selenium exposure. Fish collected from areas adjacent to the selenium-discharge sites in Martin Lake accumulated about 19.8 ppm in the hepatopancreas, compared to approximately 8.4 ppm for fish collected further from the discharge site. Reference redear sunfish accumulated normal levels of 1.8 ppm in the hepatopancreas. Hematological abnormalities were most severe for fish collected from areas adjacent to the selenium discharge site. These abnormalities included altered leukocyte distribution with elevated numbers of hemoblasts, reduced hematocrits, lower hemoglobin concentrations, slightly reduced numbers of erythrocytes, 12% and 23% reductions in mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular volume (MCV), respectively, and microcytic, poikilocytic erythrocytes with elevated numbers of nuclear shadows. These data present a striking

illustration of a case in which the hematological characteristics of a freshwater teleost were correlated with selenium accumulation in a critical organ following chronic selenium exposure. Hematological data provided a sensitive indicator of the severity of the impact of selenium-laden generator plant effluent on this teleost species. (Author's abstract)
W84-05177

EFFECTS OF ACIDIFIED WATER ON THE LOCOMOTOR BEHAVIOR OF THE GULF KILLIFISH, FUNDULUS GRANDIS: A TIME SERIES APPROACH,
Florida State Univ., Tallahassee. Dept. of Oceanography.
R. B. MacFarlane, and R. J. Livingston.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 163-168, March, 1983. 2 Fig, 3 Tab, 20 Ref. NOAA grant 04-3-158-43.

Descriptors: *Fish behavior, *Water pollution effects, *Killifish, *Acidic water, Hydrogen ion concentration, Locomotor activity, Physiological stress, Toxicity.

Behavioral responses can be an indicator of well-being under particular environmental conditions. In order to study the impact of acidification of natural aquatic systems on ecological processes, the locomotor response of fish to reduced pH was determined in Fundulus grandis, a euryhaline teleost commonly occurring in northern Gulf of Mexico estuaries. Locomotor activity of F. grandis was monitored hourly at four pH levels (7.8, 6.5, 5.0, and 4.0) for 96 hr using infrared photoelectric detection. As an internal control, the activity pattern of each fish was followed for 96 hr in pH 7.8 prior to acidification. Rhythmicity of activity patterns was progressively reduced with increased acidification. Fish became hyperactive in low pH water, particularly during the normal diurnal inactive period in pH 5.0 and 4.0. Time series analysis allowed quantitative determination of the effects of acidity on the normal diel activity pattern and suggested a useful method for detection of subtle changes in an activity regime in response to stress. In fish exposed to pH 5.0 and 4.0, there was increased secretion of mucus, changes in pigmentation, buoyancy and orientation control problems, and increased coughing. (Moore-IVI)
W84-05178

TOXICITY, BIOCONCENTRATION, AND METABOLISM OF THE HERBICIDE PROPANIL (3',4'-DICHLOROPROPIONANILIDE) IN FRESHWATER FISH,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. J. Call, L. T. Brooke, R. J. Kent, M. L. Knuth, and C. Anderson.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 175-182, March, 1983. 3 Fig, 1 Tab, 56 Ref. EPA grant R-880020-01-0.

Descriptors: *Propanil, *Toxicity, *Fish, *Bioaccumulation, Metabolism, Herbicides, Mortality, Minnows, Trout, Growth stages.

Fathead minnows (Pimephales promelas) were exposed to technical grade propanil (3',4'-dichloropropionanilide) in a flow-through diluter system to determine acute lethality. LC50 values were 11.5, 10.2, 8.6, and 3.4 mg/L at 24, 48, 96, and 192 hr, respectively. Eggs, newly hatched fry, and juvenile fish of this species were similarly exposed but at lower concentrations and for a period of 58 days. The 58-day 'no effect' concentration was between 0.4 and 0.6 micro g/L, based upon the physiological parameters of length and dry weight of juvenile fish. C-14-Propanil did not bioconcentrate significantly in fathead minnows (1.6 x for parent propanil in whole body). Rainbow trout (Salmo gairdneri) readily metabolized propanil, forming at least ten products. One metabolite recovered from trout bile was identified as either 3',4'-dichloro-2-hydroxypropionanilide or 3',4'-dichloro-3-hydroxy-propionanilide. The technical grade propanil also contained 0.67 mg.g-1 of 3,3',4,4'-tetrachloroazo-benzene as a contaminant. (Author's abstract)
W84-05180

RESPONSES OF CHANNEL CATFISH TO XENOBIOTICS: INDUCTION AND PARTIAL CHARACTERIZATION OF A MIXED FUNCTION OXYGENASE,
Oklahoma State Univ., Stillwater. Dept. of Physiological Sciences.
S. W. Fingerman, L. A. Brown, M. Lynn, and E. C. Short, Jr.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 195-201, March, 1983. 4 Fig, 1 Tab, 42 Ref.

Descriptors: *Catfish, *Benzo(a)pyrene, *Mixed function oxygenase, Phenobarbital, Water temperature, Hydrogen ion concentration, Water pollution effects, Enzyme induction.

The effects of the environmental pollutant benzo(a)pyrene (BP) were assessed on the hepatic mixed function oxygenase system (MFO) in the channel catfish, Ictalurus punctatus. Initially, the optimum conditions were established for measuring hepatic MFO in this species of fish. Parameters investigated were divalent metal ion requirement, in vitro incubation temperature for optimum activity, pH for optimum activity and the time course for enzyme induction. A single dose of BP (100 micro g/kg body weight) given intraperitoneally to catfish kept in the laboratory at 19 degrees C induced the hepatic MFO benzo(a)pyrene hydroxylase (BaPH) with maximum activity occurring 96 hr after the injection of BP. Cytochrome P450 assays were carried out at 24 hr and 48 hr after injection of BP. Hepatic cytochrome P450 and BaPH activity increased from 24 to 48 hr after the BP injection. In a temperature acclimation experiment, fish were maintained at 15 degrees, 19 degrees, and 26 degrees C; assays for BaPH were conducted 24, 48, and 96 hr after an inoculation with BP. Induction occurred equally in all BP-injected fish by 24 hr; by 48 hr, induction was greatest in the fish kept at 26 degrees C, least in the 15 degrees C group. The fish kept at 19 degrees C were intermediate. However, by 96 hr, induction had occurred to the same degree in all three experimental groups. BaPH activity was always greater in the BP-injected groups than in their respective control groups. Phenobarbital (75 mg/kg body weight) failed to cause an increase in hepatic dealkylating activities or cytochrome P450 concentration. (Author's abstract)
W84-05181

TEMPORAL ACCUMULATION OF ORGANOCHLORINE PESTICIDES IN SHOREBIRDS WINTERING ON THE SOUTH TEXAS COAST, 1979-80,
Patuxent Wildlife Research Center, Victoria, TX. Gulf Coast Field Station.
D. H. White, C. A. Mitchell, and T. E. Kaiser.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 2, p 241-245, March, 1983. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Organochlorine pesticides, *Texas, *Birds, Agricultural runoff, DDE, Dieldrin, Toxaphene, Dowitchers, Avocets, Sandpipers, Pesticide residues, DDT, Shorebirds, Drainage.

Organochlorine pesticide residues were determined in 168 shorebirds of three species collected at approximate bimonthly intervals during the fall and winter months of 1979-80 near Port Mansfield on the south Texas coast. The study was conducted to determine if shorebirds wintering on mudflats at the outlets of agricultural drains in Texas accumulated pesticides during this period. The predominant organochlorine residues detected in shorebirds were DDE, dieldrin, and toxaphene. Ninety-five percent of the skinned carcasses analyzed contained detectable levels of DDE, 13% contained dieldrin, and 22% contained toxaphene. DDE significantly increased in all species of shorebirds from October to December, with potentially dangerous levels accumulating in some long-billed dowitchers (Limnodromus scolopaceus) and American avocets (Recurvirostra americana), but DDE residues seldom exceeded 0.5 ppm in carcasses of western sandpipers (Calidris mauri). After about two months on the study area, no further residue increases were documented. The high levels of DDE detected in a large proportion of the dowitchers, and to a lesser extent in the avocets, are near or within the range known to inhibit reproduction in some avian species. This study demonstrates that certain aquatic areas near agricultural lands on the south Texas coast may be potential threats to waterbirds eight years after the use of DDT was banned in the United States. (Author's abstract)
W84-05183

PETROLEUM HYDROCARBON CONCENTRATIONS IN A SALMONID STREAM CONTAMINATED BY OIL FIELD DISCHARGE WATER AND EFFECTS ON MACROBENTHOS,
Columbia National Fisheries Research Lab., Jackson, WY. Field Research Lab.-Jackson.
D. F. Woodward, and R. G. Riley.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 3, p 327-334, May, 1983. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Oil wastes, *Hydrocarbons, *Oil pollution, *Benthos, Water pollution effects, Effluents, Sediment pollution, Heavy metals, Plecoptera, Trichoptera, Diptera, Fisheries, Zinc.

The concentration of total hydrocarbons in the water effluent from an oil field was 5.6 mg/L and resulted in concentrations of 46 to 85 micro g/L in the receiving stream. Total hydrocarbons were 55,000 times more concentrated in the sediment than in the water, ranging from 979 (778) to 2,515 (1,263) mg/kg. Saturated hydrocarbons contributed most to the total hydrocarbon concentration in both water and sediment. Naphthalenes were found in stream water, but not in sediment. Cadmium, chromium, copper, lead, and zinc were detected in water and sediment. Zinc was elevated in the sediment, probably because an organic zinc complex was used by the oil company during processing to enhance oil-water separation. Species diversity of macrobenthos was reduced below the discharge, as evidenced by the almost complete elimination of Plecoptera and Trichoptera. Shannon-Weaver diversity index values ranged from 3.4 at the upstream control station to 1.2 to 1.7 below the oil field effluent. The representation of Diptera increased from 10% of the total insects at the least polluted station to 46% at the station containing the most dissolved hydrocarbons. On the basis of the findings, discharge of oil into fresh water should be closely regulated to prevent the development of concentrations in water and sediment of the receiving stream that would alter the structure of macrobenthos communities and thereby threaten the fishery resources. (Author's abstract)
W84-05185

SELENITE TOXICITY AND MERCURY-SELENIUM INTERACTIONS IN JUVENILE FISH,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. F. Klaverkamp, D. A. Hodgins, and A. Lutz.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 4, p 405-413, July, 1983. 4 Fig, 2 Tab, 73 Ref.

Descriptors: *Selenium, *Mercury, *Toxicity, *Fish, Juvenile growth stage, Mortality, Pike, Sucker, Perch, Heavy metals, Water pollution effects, Methyl mercury.

Selenium may have potential as a chemical amelioration measure in freshwater ecosystems contaminated by mercury. Acute lethal toxicities of selenium and the effects of selenium on mercury accumulation were determined in freshwater fish species. Selenite concentrations required to produce 50% mortality were approximately 11 mg Se/L in northern pike (Esox lucius), 29 mg Se/L in white sucker (Catostomus commersoni), and 5 mg Se/L in yellow perch (Perca flavescens) after 75, 96, and 240 hr of exposure, respectively. Two approaches were used to determine effects of water-borne sele-

nium on mercury concentrations in northern pike. A trend of reduced mercury contamination at a low selenium concentrations (1 micro g Se/L) with maintenance at control mercury contamination levels at a higher selenium concentration (100 micro g Se/L) was apparent in the first approach. A similar response of decreased CH3 Hg-203 accumulation in muscle-skin at lower selenium concentrations (1 and 10 micro g Se/L), but maintenance at control accumulation levels at a higher selenium concentration (100 micro g Se/L) was observed in the second approach. Selenium addition to mercury-contaminated freshwater ecosystems may have beneficial effects in reducing mercury concentrations in fish and other aquatic biota and in antagonizing mercury toxicity. (Moore-IVI)
W84-05186

JOINT TOXICITY OF MERCURY AND SELENIUM IN SALMONID EGGS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. F. Klaverkamp, W. A. Macdonald, W. R. Lillie, and A. Lutz.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 4, p 415-419, July, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Trout, *Mercury, *Selenium, *Toxicity, *Fish eggs, Heavy metals, Water pollution effects, Mortality, Synergism.

Release of selenium and mercury to the atmosphere by industrial activities and subsequent deposition to the aquatic environment is resulting in gradual increases in contamination of freshwater ecosystems. While biological interaction between mercury and selenium generally result in decreased toxicity, a rare example of toxicity enhancement has been reported in carp eggs. Toxic interactions between mercury and selenium in fertilized eggs of rainbow trout (Salmo gairdneri) and lake trout (Salvelinus namaycush) were investigated under static conditions in polyethylene exposure containers. Mercury produced concentration-dependent decreases in median survival times and caused decreases in median hatch times. Selenium, at concentrations up to 10 mg Se/L, had no effect on hatching times, and did not produce mortality, and had no effect on mercury toxicity. At concentrations of 100 mg Se/L and higher, an apparent protective effect of selenium on mercury toxicity was observed in lake trout eggs. The marked synergistic effect between selenium and mercury was not observed in this study. (Moore-IVI)
W84-05187

FUNCTIONAL PROPERTIES OF A MICROCOSM OF THE FRESHWATER BENTHIC ZONE AND THE EFFECTS OF 2,4-DICHLOROPHENOL,
Argonne National Lab., IL. Radiological and Environmental Research Div.
P. A. Szczepanik-van Leeuwen, and W. R. Penrose.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 4, p 427-437, July, 1983. 10 Fig, 8 Tab, 15 Ref. Contract W-31-109-ENG-38.

Descriptors: *Microcosms, *Lake sediments, *Benthic environment, *Dichlorophenol, Decomposition, Carbon radioisotopes, Pontoporeia, Toxicity, Mortality, Organic carbon, Lake Michigan, Particulates.

A sediment-water microcosm system was evaluated that was designed to address some ecosystem functions selected a priori for their significance to man's use of lakes: (a) the decomposition of organic carbon, (b) secondary production, and (c) the binding or degradation of toxic chemicals. 2,4-Dichlorophenol (DCP) was chosen as a 'typical' toxic chemical. The microcosms were undisturbed cores recovered from a high-deposition area of Lake Michigan and dosed with a trace amount of C-14-alanine. The measurements found to be interpretable in terms of ecosystem functions were (a) turn-over of non-acid-volatile radiocarbon, (b) turnover of particulate radiocarbon, (c) rate of attachment of radiocarbon-labelled organisms to glass surfaces, (d) sediment penetration of radiocarbon, (e) mortality of benthic fauna (especially pontoporeia), and (f) toxicant concentrations. Lethal toxicity of DCP to Pontoporeia sp. in the microcosms agreed with that determined in controlled bioassays (96-hr LC50: 2.5 mg/L). Functions of the microbial community were initially inhibited by 81 mg/L DCP, but recovered in six days. The rates of radiocarbon turnover were reduced throughout the 21-day experiments even at the lowest concentration of DCP, 1.0 mg/L. These experiments have shown that a microcosm approach can yield quantitative estimates of the effects of toxicants on the functional properties of lake benthic ecosystems. (Author's abstract)
W84-05188

ACCUMULATION, SUBLETHAL EFFECTS, AND SAFE CONCENTRATION OF A REFINED OIL AS EVALUATED WITH CUTTHROAT TROUT,
Columbia National Fisheries Research Lab., Jackson, WY. Field Research Lab.-Jackson.
D. F. Woodward, R. G. Riley, and C. E. Smith.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 4, p 455-464, July, 1983. 7 Fig, 5 Tab, 25 Ref.

Descriptors: *Trout, *Toxicity, *Oil, Water pollution effects, Bioaccumulation, Oil pollution, Hydrocarbons, Naphthalenes, North Platte River, Wyoming.

Cutthroat trout (Salmo clarki) were exposed for 90 days in the laboratory to a refined oil collected from the North Platte River at a seepage site below the American Oil Company refinery at Casper, Wyoming. Fish were exposed to five concentrations and a control, and seven biological responses (survival, growth, gill pathology, liver pathology, caudal fin erosion, caudal fin pathology and swimming performance) were correlated with water concentration and tissue accumulation of petroleum hydrocarbons. Fish in the highest water concentration, 183 micro g/L total oil, accumulated tissue concentrations of 4.6 micro g/g total naphthalenes and responded adversely to all seven biological measurements. Cutthroat trout in the lowest water concentration, 24 micro g/L total oil, had a mean tissue concentration of 1.2 micro g/g total naphthalenes, but their response was similar to that of the control fish to all seven biological responses. Fish exposed to 39 micro g/L water concentration accumulated tissue concentrations of 2.7 micro g/g responded negatively to 2 of the 7 biological measurements. Therefore, the maximum safe limit for this oil and cutthroat trout is between 24 and 39 micro g/L. (Author's abstract)
W84-05189

UPTAKE OF LEAD FROM AQUATIC SEDIMENT BY SUBMERSED MACROPHYTES AND CRAYFISH,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
M. F. Knowlton, T. P. Boyle, and J. R. Jones.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 5, p 535-541, September, 1983. 1 Fig, 7 Tab, 17 Ref.

Descriptors: *Lead, *Aquatic plants, *Crayfish, *Sediment contamination, Water pollution effects, Submerged plants, Path of pollutants, Exoskeleton, Molting, Heavy metals.

Lead compounds and organic complexes are generally insoluble in natural waters so most Pb in contaminated aquatic ecosystems is found in the sediments. Macrophytes and crayfish are in physical contact with aquatic sediments and could serve as vectors in the transmission of Pb into food chains. Uptake of lead (Pb) by submersed aquatic macrophytes and crayfish exposed to artificially contaminated pond sediment was measured under laboratory conditions. Macrophytes accumulated Pb in root tissue and foliage. Concentrations in live foliage ranges from 5 to 89 micro g Pb/g compared with an average of 3 micro g Pb/g in uncontaminated plants. Internal transport of Pb by plants was not detected. Senescent macrophytes accumulated more lead (248 to 361 micro g Pb/g) than live plants. Crayfish exposed to contaminated sediment accumulated Pb principally through adsorption to the exoskeleton and lost Pb through molting, although internal uptake and elimination without molting was measurable. Exposure to Pb leached from sediment, surface to weight ratios, and frequency of molting seem to influence Pb uptake by crayfish. Lead concentrations in crayfish collected during the exposure period ranged from 2 to 310 micro g Pb/g. The uptake of Pb by macrophytes and crayfish exposed to contaminated sediments is consistent with the role of sediment not only as a sink for metal contamination but also as a continuous source of heavy metals to the aquatic biota after contamination from the original source has subsided. (Moore-IVI)
W84-05190

ACUTE TOXICITY OF BUTYLBENZYL PHTHALATE TO SHINER PERCH (CYMATOGASTER AGGREGATA),
Corvallis Environmental Research Lab., OR.
R. J. Ozretich, R. C. Randall, B. L. Boese, W. P. Schroeder, and J. R. Smith.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 655-660, November, 1983. 2 Fig, 2 Tab, 26 Ref. NIEHS grant ESO 1926.

Descriptors: *Toxicity, *Butylbenzyl phthalate, *Perch, Phthalate esters, Bioassay, Fish behavior, Catecholamines, Industrial chemicals.

Butylbenzyl phthalate (BBP) is a member of a class of compounds which are esters of phthalic anhydride, and are used extensively in the plastics industry. As a result of the ubiquity of BBP in environmental samples and its high production, the EPA included it with several other phthalate esters in a list of toxic pollutants, for which acute bioassays are required for at least two different fish families. Static bioassay LC50s for butylbenzyl phthalate (BBP) for a single species of marine fish were based on nominal doses range from 3 mg/L to 440 mg/L. Flow-through bioassays were used in this study of BBP with shiner perch (Cymatogaster aggregata). Using measured exposure concentrations, 96-hr LC50s averaged 0.51 mg/L. Effects on schooling behavior were found at 0.08 mg/L and coloration at 0.24 mg/L. Coupled with the behavioral changes, reduced brain levels of epinephrine found in surviving fish indicated that the mode of acute toxicity for BBP may be through its effects on the catecholamines of the central adrenergic nervous system. At concentrations as low as 0.08 mg/L, behavior which can be essential to survival in the wild can be altered. (Moore-IVI)
W84-05194

ACUTE TOXICITY OF TEN CHLORINATED ALIPHATIC HYDROCARBONS TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS),
Environmental Research Lab.-Duluth, MN.
C. T. Walbridge, J. T. Fiandt, G. L. Phipps, and G. W. Holcombe.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 661-666, November, 1983. 3 Tab, 26 Ref.

Descriptors: *Toxicity, *Chlorinated ethanes, *Minnows, Chlorinated hydrocarbons, Aliphatic hydrocarbons, Solvents, Water pollution effects, Industrial chemicals, Tetrachloroethylene, Tetrachloroethane, Pentachloroethane, Trichloroethane, Hexachlorobutadiene, Trichloroethylene, Dichloropropane, Dichloroethane, Hexachloroethane, Dichloropropane.

The tested chlorinate ethanes are used for metal cleaning in industry, as solvents for waxes, oils, and resins, and as chemical feedstocks. Ninety-six hour LC50 values were determined for 10 chlorinated aliphatic hydrocarbons in freshwater flow-through toxicity tests on fathead minnows (Pimephales promelas). Laboratory-reared minnows, 30 to 35 days old were used. With the exception of hexachlorobutadiene, the effect of these compounds is narcotic; lethargy and anesthesia are observed. The directly observable effect of hexachlorobutadiene is hemorrhaging. The toxicity

goes up directly with the ratio of chlorine to total molecular weight. The 96-hr measured LC50 values in mg/L from combined duplicate tanks were: tetrachloroethylene 13.4; 1,1',2,2'-tetrachloroethane 20.4; pentachloroethane 7.34; 1,1',2-trichloroethane 81.6; hexachlorobutadiene 0.10; 1,1'2-trichloroethylene 45.0; 1,2-dichloropropane 140; 1,2-dichloroethane 116; hexachloroethane 1.51; 1,3-dichloropropane 131. The 1,1',2-trichloroethane results were unusual in that all of the deaths that were to occur during the four days of the test happened in the first five hours. (Moore-IVI)
W84-05195

ACTIVITY AND INDUCIBILITY OF ARYL HYDROCARBON HYDROXYLASE IN THE EELPOUT ZOARCES VIVIPARUS (L.),
Odense Univ. (Denmark). Inst. of Biochemistry.
R. Jensen, and J. Knudsen.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 673-678, November, 1983. 10 Fig, 33 Ref.

Descriptors: *Aryl hydrocarbon hydroxylase, *Zoarces, *Naphthalene, Polycyclic aromatic hydrocarbons, Toxicity, Metabolism, Oil pollution, Water pollution effects, Embryonic growth stage.

Naphthalene, a major component of the water soluble fraction of oil, is usable as a model substrate for the metabolic activation of other polycyclic aromatic hydrocarbons (PAH). Naphthylene and other PAHs are metabolized via aryl hydrocarbon hydroxylase (AHH). The AHH activity in eelpout liver microsomes was determined with C-14-naphthalene as substrate. Exposure to 0.5 ppm naphthalene in the water for one week or intraperitoneal injection (ip.) of naphthalene in peanut oil (100 mg/kg) did not induce AHH activity in the liver microsomes of adult female eelpouts, which was in contrast to ip. of 5,6-benzoflavone (5,6-BF) (100 mg/kg) which increased the AHH activity three fold. 7,8-Benzoflavone (7,8-BF) inhibited the AHH activity in vitro in 5,6-BF induced fish, but it increased the AHH activity in control fish. The AHH system in eelpout embryos was almost fully active before parturition, and no major change took place at parturition. (Moore-IVI)
W84-05196

ACUTE AND CHRONIC TOXICITY OF SOME CHLORINATED BENZENES, CHLORINATED ETHANES, AND TETRACHLOROETHYLENE TO DAPHNIA MAGNA,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
J. E. Richter, S. F. Peterson, and C. F. Kleiner.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 679-684, November, 1983. 3 Tab, 18 Ref.

Descriptors: *Toxicity, *Daphnia, *Chlorinated hydrocarbons, Growth, Reproduction, Tetrachloroethylene, Hexachloroethane, Pentachloroethane, Tetrachloroethane, Trichloroethane, Dichloroethane, Trichlorobenzene, Dichlorobenzene.

Chronic effect and no effect concentrations (28 day) and acute toxicity (48 hr, LC50 and EC50) values were determined for Daphnia magna with some chlorinated benzenes, chlorinated ethanes, and tetrachloroethylene. Acute and chronic toxicity generally increased with the degree of chlorine substitution with these chemicals. The 48 hr LC50 values for hexachloroethane, pentachloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2,4-trichlorobenzene, 1,3-dichlorobenzene, and tetrachloroethylene were 2.9, 7.3, 62, 190, 270, 2.1, 7.4, and 18 mg/L, respectively. The lowest observable effect concentrations (LOEC) based on either reproductive impairment or growth for 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2-dichloroethane, 1,2,4-trichlorobenzene, 1,3-dichlorobenzene, and tetrachloroethylene were 14, 26, 20, 0.69, 1.5, and 1.1 mg/L, respectively. Length of animals at the end of chronic exposure was at least as sensitive a measure of toxic effect as reproduction with every chemical tested except 1,2-dichloroethane. The acute-chronic ratio ranged from 3 to 16 with these chemicals. (Author's abstract)
W84-05197

SLOW ACCUMULATION OF LEAD FROM CONTAMINATED FOOD SOURCES BY THE FRESHWATER GASTROPODS, PHYSA INTEGRA AND CAMPELOMA DECISUM,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
M. C. Newman, and A. W. McIntosh.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 685-692, November, 1983. 2 Fig, 3 Tab, 13 Ref. Contract DE-AC09-76-SROO-H19.

Descriptors: *Lead, *Gastropods, *Food, Aufwuchs, Heavy metals, Snails, Water pollution effects, Physa, Campeloma.

The relative significance of dietary and water sources of lead to aquatic biota remains generally unresolved. The accumulation of lead from two highly contaminated food sources was examined in order to further define the factors contributing to the observed differences in soft tissue lead concentrations in the freshwater gastropods Physa integra and Campeloma decisum. Lead was slowly accumulated from aufwuchs (0.52-0.87 micro g Pb/g dry wt of tissue/day) by the grazing snail, P. integra while no statistically significant lead accumulation from sediments was noted in the deposit/suspension feeder, C. decisum. Lead concentrations in all of the aufwuchs samples were approximately 125 micro g Pb/g dry weight. Aufwuchs-associated iron and manganese did not affect the bioavailability of lead. C. decisum appears to be able to control the amount of lead accumulating in its tissues. (Moore-IVI)
W84-05198

AVOIDANCE BEHAVIOR OF JUVENILE STRIPED BASS, MORONE SAXATILIS, SUBJECTED TO SIMULTANEOUS CHLORINE AND ELEVATED TEMPERATURE CONDITIONS,
Johns Hopkins Univ., Shady Side, MD. Aquatic Ecology Section.
L. W. Hall, Jr., S. L. Margrey, D. T. Burton, and W. C. Graves.
Archives of Environmental Contamination and Toxicology, Vol. 12, No. 6, p 715-720, November, 1983. 4 Fig, 4 Tab, 22 Ref. Maryland Power Plant Siting Program contract P83-81-04.

Descriptors: *Bass, *Avoidance behavior, *Chlorine, *Water temperature, Juvenile growth stage, Fish behavior, Acclimation, Residual chlorine, Water pollution effects.

The avoidance responses of juvenile striped bass (Morone saxatilis) were evaluated by exposing test organisms to simultaneous elevated temperature (0, 2, 4, and 6 degrees C) and total residual chlorine (TRC) (0.00, 0.05, 0.10 and 0.15 mg/L) conditions at four acclimation temperatures ranging from 15-30 degrees C. An unbalanced 3-factor factorial design was used to develop response surface avoidance models at all acclimation temperatures. The percent avoidance models at 15 degrees C showed that the interaction term (TRC x delta T) was the most important term influencing avoidance; TRC was the most important factor at 20 degrees C; the models at 25 and 30 degrees C showed that delta T was the most important factor. The results of tests conducted at 15 degrees C suggest that preference for a higher temperature overrides a chlorine avoidance response to 0.15 mg/L TRC. Avoidance responses of striped bass tested at acclimation temperatures of 20, 25, and 30 degrees C showed that preference for a higher temperature (6 degrees C delta T) did not override a chlorine avoidance response. A significant difference ($p < 0.01$) existed between avoidance models at all acclimation temperatures; greatest avoidance generally occurred for all combinations of test conditions at 30 degrees C. (Author's abstract)
W84-05201

PALEOLIMNOLOGICAL RECONSTRUCTION OF THE EFFECTS OF ATMOSPHERIC DEPOSITION OF ACIDS AND HEAVY METALS ON THE CHEMISTRY AND BIOLOGY OF LAKES IN NEW ENGLAND AND NORWAY,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
R. B. Davis, S. A. Norton, C. T. Hess, and D. F. Brakke.
Hydrobiologia, Vol. 103, 113-123, July, 1983. 8 Fig, 29 Ref. NSF grant DEB7810641, FWS grant 1416000979040, USDA grant ME08465 and OWRT grant A048ME.

Descriptors: *Lake acidification, *Norway, *New England, *Heavy metals, *Paleolimnology, Acid rain, Atmospheric deposition, Cladocera, Cesium radioisotopes, Lead radioisotopes, Pollen, Diatoms, Soil erosion, Iron, Soil acidification, Land use, Water pollution sources.

The degree and chronology of acidification and associated pollution of lakes in southern Norway and northern New England by heavy metals is poorly known, due to the scarcity of long-term series of direct measurements. Sediment cores from nine lakes in southern Norway (N) and six in northern New England (NE) were dated by Cs-137, Pb-210 and in NE also by pollen, and were analyzed geochemically and for diatoms. Cores from two N and three NE lakes were analyzed for cladocerans; Cs-137 dating is unreliable in these lakes, probably due to mobility of Cs in the sediment. In Holmvatn sediment, an up-core increase in Fe, starting ca. 1900, correlates with geochemical indications of decreasing mechanical erosion of soils. Diatoms indicate a lake acidification starting in the 1920's. Soil Fe was mobilized and runoff acidified by acidic precipitation and/or by soil acidification resulting from vegetational succession following reduced grazing. Even minor land use changes or disturbances in lake watersheds introduce ambiguity to the sedimentary evidence relating to atmospheric influences. Diatom counts from surface sediments in 36 N and 31 NE lakes were regressed against contemporary water pH to obtain coefficients for computing past pH from subsurface counts. Computed decreases of 0.3-0.8 pH units starts between 1890 and 1930 in N lakes already acidic (pH 5.0-5.5) before the decrease. These and lesser decreases in other lakes start decades to over a century after the first sedimentary indications of atmospheric heavy metal pollution. The acidification of precipitation probably accompanied the metal pollution. Delays in lake acidification may be due to buffering by the lakes and watersheds. The magnitude of acidification and heavy metals loading of the lakes parallels air pollution gradients. A shift in cladoceran remains is contemporary with acidification, preceding elimination of fishes. (Moore-IVI)
W84-05215

CULTURAL DISTURBANCES AND TROPHIC HISTORY OF A SMALL MEROMICTIC LAKE FROM CENTRAL CANADA,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
J. P. Smol, S. R. Brown, and R. N. McNeely.
Hydrobiologia, Vol. 103, p 125-130, July, 1983. 4 Fig, 34 Ref. Natural Sciences and Engineering Research Council of Canada grant A-808.

Descriptors: *Meromictic lakes, *Eutrophication, *Little Round Lake, *Ontario, *Salt, Highways, Environmental effects, Pollen, Limnology, Diatoms, Logging, Chrysophyta, Oligotrophy.

Little Round Lake occupies a small, deep, cup-shaped basin in southeastern Ontario. The lake is presently oligo-mesotrophic and is chemically stratified with a distinct chemocline near the 11 m level. The watershed has been subjected to moderate cultural disturbances over the last century; first by loggers and the building of a railroad adjacent to the lake, and later by the construction of two highways. Pollen analyses were used to identify past changes in terrestrial vegetation, while limnological conditions were interpreted on the basis of diatom and chrysophyte microfossils. Contemporaneous with the arrival of European settlers (ca. A.D. 1850), the predisturbance assemblage of oligotrophic Cyclotella diatoms was replaced by Synedra spp., which then succeeded to a eutrophic flora dominated by Stephanodiscus hantzschii. Synuracean algae were almost completely ex-

cluded. Both the diatom and chrysophyte microfossils recorded a marked return to oligotrophy over the last 30 years. Stephanodiscus hantzschii was reduced to trace levels and the diatom assemblage was dominated by oligotrophic taxa. Synuracean scales were common. This shift may be related to the cultural enhancement of meromixis by the seepage of road salt from the two adjacent highways and a salt storage shed in the drainage basin. Although an increase in meromictic stability appears to have greatly reduced algal productivity, the species composition in the surface sediments suggests that the lake is still slightly more eutrophic than it was prior to man's arrival. (Moore-IVI)
W84-05216

CHANGES OF THE BENTHIC FAUNA OF THE PROFUNDAL ZONE OF TRAUNSEE (AUSTRIA) DUE TO SALT MINING ACTIVITIES,
Vienna Univ. (Austria). Limnologische Lehrkanzel.
H. Loffler.
Hydrobiologia, Vol. 103, p 135-139, July, 1983. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Benthic fauna, *Traunsee, *Austria, *Salt mining, Mine wastes, Mine drainage, Alkalinity, Paleolimnology, Artificial meromixis, Ostracods.

Traunsee is the deepest (189 m) lake in Austria and has been holomictic until the beginning of industrial discharges from the alkali works in Ebensee. The input of soluble compounds such as CaCl2 and NaCl have produced meromictic conditions. The relatively high oxygen content of the monimolimnion is due to water movements promoted by the large inflow and wind-action. The industrial discharges have caused both meromictic conditions and the deposition of highly alkaline sediment in the southern portion of the profundal zone. The effect of the discharges on the benthic fauna was evaluated by comparing the subfossil benthic fauna of four cores taken inside and outside the affected area. The ostracod fauna resembles that of other large lakes in the Salzkammergut, but also includes groundwater species such as Kovalevskiella and Cypridopsis subterranea. Leucocythere mirabilis has been found for the first time in an Australian lake. Ostracods and other benthic organisms such as Testacea were not apparently influenced by the meromictic condition. They are, however, missing in all areas covered by the alkaline sludge. (Author's abstract)
W84-05218

CLADOCERAN REMAINS AS EVIDENCE OF CHANGE IN TROPHIC STATE IN THREE SWISS LAKES,
Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W84-05219

EUTROPHICATION PROCESSES IN SPANISH RESERVOIRS AS REVEALED BY BIOLOGICAL RECORDS IN PROFUNDAL SEDIMENTS,
Barcelona Univ. (Spain). Facultat de Biologia.
For primary bibliographic entry see Field 2H.
W84-05221

EUTROPHICATION AND THE DISAPPEARANCE OF LAKES IN THE BRODNICA LAKE DISTRICT, NORTHERN POLAND AS A RESULT OF HUMAN INTERFERENCE,
Nicolas Copernicus Univ. of Torun (Poland). Inst of Geography.
For primary bibliographic entry see Field 2H.
W84-05223

ZN, P AND ATP IN THE SEDIMENTS OF TWO LAKES IN SOUTH FINLAND,
Tampere Univ. of Technology (Finland).
L. Koivo, and R. Oravainen.
Hydrobiologia, Vol. 103, p 177-179, July, 1983. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Lake sediments, *Tampere, *Finland, Zinc, *Phosphorus, *Adenosine triphosphate, Industrial wastes, Municipal wastes, Sedimentation, Textile plants, Pulp and paper industry, Pulp wastes, Eutrophication.

The impact of industrial and municipal waste discharge on lakes near the city of Tamere, Finland was investigated. The record of P, Zn and ATP in the recent sediments of Vanajavesi I, a polluted lake, and Mallasvesi, a largely unpolluted lake, are compared. The study lakes are situated in the Kokemaenjoki watercourse in South Finland, with an area of about 27,040 sq km. Sources of pollution in the area are pulp and paper mills, textile factories, municipal sewage plants and fish-farms. Mallasvesi is a clear water lake with a low nutrient and electrolyte status although oxygen deficiency occurs in depressions in the lake bed during stratification. There is a slight increase in P values in the upper 30 cm, but Zn values are consistently low throughout. Vanajavesis I is heavily polluted due to discharge of industrial and municipal effluents. The zinc load (1000 kg/day) from a textile factory has been cut recently to 100 kg/d. Other problems have begun to improve due to the installation of a wastewater treatment plant. (Baker-IVI)
W84-05224

CLOSTRIDIUM PERFRINGENS (HOLLAND) AS AN INDICATOR OF HUMAN EFFLUENT IN THE SEDIMENT OF LAKE TUOMIOJARVI, CENTRAL FINLAND,
Jyvaeskylae Univ. (Finland). Hydrobiological Research Center.
K. Granberg.
Hydrobiologia, Vol. 103, p 181-184, July, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Eutrophication, *Lake Tuomiojarvi, *Finland, *Clostridium, Lake sediments, Domestic wastes, Wastewater, Paleolimnology, Bacteria.

The horizontal and vertical distribution of the gram-positive, non-motile, spore-forming and rod-shaped bacterium Clostridium perfringes was studied to estimate the quantity of C. perfringens at different depths of the sediment in Lake Tuomiojarvi and, thereby, evaluate the effect of human effluent which the lake received between 1940 and 1956. The amounts of Clostridium increased at the same level (40 mm) where redox potential decreased in the sediment due to the beginning of effluent disposal. The maximum Cu:Zn ratio seems to have been in the 1950's. A slight increase in loss of ignition values is noted and may be related to enrichment processes in the lake. The amount of chlorophyll a in the sediment varied between 42 and 74 micro g/g dry weight. An increase is seen in the top 20 mm. The comparison of chlorophyll a to the numbers of diatom values does not show a clear correlation. At 35 mm the number of diatoms decreases although the amount of chlorophyll a increases. The pre-pollution level of Clostridium in Lake Tuomiojarvi is less than 300 colonies/g dry weight, judging from the values found in the sediment deeper than 30 mm. (Baker-IVI)
W84-05225

SYSMAJARVI - A LAKE POLLUTED BY MINING WASTE-WATER,
North Karelian Water District Office, Joensuu (Finland).
M. Ahtiainen, O. Sandman, and R. Tynni.
Hydrobiologia, Vol. 103, p 303-308, July, 1983. 5 Fig, 2 Tab, 9 Ref.

Descriptors: *Lake sediments, *Mine wastes, *Lake Sysmajarvi, Industrial wastes, Heavy metals, Diatoms, Paleolimnology, Acid mine drainage, Lime, History, Nutrients, Water pollution effects.

Lake Sysmajarvi is located inside the municipal boundary of Outokumpu, Finland. The evolution of Lake Sysmajarvi was investigated with special respect to the effects of acidification and subsequent liming recorded by the diatom flora and heavy metal content of the sediment and by historical records. According to the pollen diagram and pollen zonation, the base of the 480 cm sediment core from the deep part of the lake belongs to the Preboreal Betula-phase, Zone IV. The whole core spans more than 9000 years. The lower part of the sediment was deposited in the Yoldia phase: the typical diatom at 440 cm is Melosira islandica spp. helvetica and there is also a small quantity of Diploneis interrupta. In the short core the influence of man can be detected from about 40 cm to the sediment surface, represented by increases in the proportion of organic matter, alkaliphilous and alkalibionitic diatoms and heavy metals. This change can be attributed to the effect of waste from the mining industry. The radical pH changes seem to have had a smaller influence on the amounts of organic matter and metals in the sediment. Some of the water polluted by the mining waste and most of the municipal sewage enters via the river Lahenjoki. The effects of large amounts of nutrients can be noticed most clearly where the river enters the lake, but effects can also be noted over the whole eastern, shallow part of the lake. (Baker-IVI)
W84-05227

ATTEMPT TO TRACE EUTROPHICATION IN A SHALLOW LAKE (BALATON, HUNGARY) USING CHIRONOMIDS,
Lajos Kossuth Univ., Debrecen (Hungary). Dept. of Ecology.
G. Devai, and J. Moldovan.
Hydrobiologia, Vol. 103, p 169-175, July, 1983. 5 Fig, 15 Ref.

Descriptors: *Eutrophication, *Tracers, *Lake Balaton, *Hungary, *Chironomids, Water quality, Paleolimnology, Subfossil remains, Eutrophic lakes.

Lake Balaton, the largest shallow lake in Central Europe, is about 20000 years old. An enormous increase in tourism and the disproportionate building development of the last few decades has resulted in the acceleration of eutrophication in the lake. The larvae of non-biting midges (Diptera: Chironomidae) in the sediment of the open-water zone was investigated to reveal the causes of water-quality deterioration. The contemporary faunal composition strongly correlates with the trophic gradient along the longitudinal axis of the lake. It is supposed that the eutrophication process should be identifiable from the analysis of subfossil chironomid head capsules from the upper (15 cm thick) layer of the sediment. Quantitative results could only be obtained when fragments as well as relatively intact head capsules are considered. The data verify that the originally oligo-mesotrophic community has been gradually replaced by eutrophic species in a west to east direction. Large-bodied larvae belonging to the Chironomus plumosus group mix the sediment down to 15 cm as they build their tubes and consequently alter the original proportions of head capsules at the different levels. The sequence of communities through the sediment-layers is not quite reliable. (Murphy-IVI)
W84-05229

NOTES ON THE ROTIFERS OF COAL MINE WATER IN EASTERN POLAND,
Akademia Rolnicza, Lublin (Poland). Dept. of Zoology and Hydrobiology.
S. Radwan, and A. Paleolog.
Hydrobiologia, Vol. 104, p 307-309, August, 1983. 3 Fig, 8 Ref.

Descriptors: *Coal mine wastes, *Reservoirs, *Rotifers, *Poland, Eutrophication, Sulfides, Chlorides, Temperature effects, Water pollution effects.

The species composition and quantitative structure of the rotifer fauna was investigated in a reservoir containing coal mine water. Only nine mainly planktonic species of rotifers were found. Two of these dominated: Brachionus angularis and B. rubens. They are typical indicators of eutrophic waters. Chlorides and sulfates may have an influence on the occurrence and quantitative structure of rotifer assemblages in the investigated reservoir. There was a clear positive correlation between temperature, dissolved oxygen concentration and abundance of predominating rotifers, just as in natural lakes. However, with a decrease in temperature connected with an increase of oxygen con-

centration, the abundance of some rotifer species decreased. (Baker-IVI)
W84-05230

PRODUCTION OF PLANKTONIC ROTATORIA IN ORMAJARVI, AN EUTROPHICATED LAKE IN SOUTHERN FINLAND,
Helsinki Univ. (Finland). Dept. of Environmental Science.
V. Cajander.
Hydrobiologia, Vol. 104, p 329-333, May, 1983. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Rotifers, *Eutrophic lakes, *Lake Ormajarvi, *Finland, Aquatic productivity, Secondary productivity, Species composition.

Rotifers can make a substantial contribution to secondary production in fresh waters in spite of their small relative contribution to total zooplankton biomass. It has been noticed that the eutrophication process can strongly affect numbers, standing crops, population dynamics, production and community structure of zooplankton. Such trophic changes in lake ecosystems are often favorable for rotifers. The production of planktonic rotifers was studied in eutrophic Lake Ormajarvi. Of the total annual production of rotifers (2.9 g org. C/sq m or 231 mg dry weight/cu m) 49% was achieved during one month (July) and 88% during 3 months of summer. The most important producers were Keratella cochlearis (1.2 g C/sq m), Asplanchna priodonta (0.8 g C/sq m) and Conochilus unicornis (0.6 g C/sq m). The P/B ratio for the total rotifer community during the growing season (7 months) was 25.0; monthly P/B values varied between 0.3 and 5.2. The daily P/B values were highest among species of Collotheca. The relationships of rotifers to some biotic and abiotic factors (invertebrate predators - Mesocyclops, Cladocera, planktonic Protozoa and temperature) are briefly discussed. (Murphy-IVI)
W84-05231

IMPORTANCE OF BIOTESTS TO DETERMINE THE TOXIC EFFECTS OF SEWAGE (DIE BEDEUTUNG VON BIOTESTS FUR DIE TOXIZITATSBESTIMMUNG VON ABWASSER),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
U. Pagga.
Wasserwirtschaft, Vol. 73, No. 3, p 65-70, March, 1983. 9 Fig, 7 Ref.

Descriptors: *Biological wastewater treatment, *Toxicity, *Bioassay, Measuring instruments, Sublethal effects, Water pollution effects, Chemical composition, Chemical analysis.

Purification plants are nothing more than breeding grounds for microorganisms. Some significant problems will arise if toxic substances enter these biological wastewater treatment processes. To reduce the hazard biotests are conducted to determine the extent of the toxic substance intrusion. Toxic effects of chemical substances and waste water on activated sludge and water organisms are discussed. Principal methods to measure these effects are a short time respiration test and a respirometric test with activated sludge, a continuous respiration test called a BASF-Toximeter to monitor a waste water, an enzymatic test (TTC-Test), an acute fish test with golden ides and a long time test with waterfleas (Daphnia), to detect sublethal effects. Finally the evaluation of test results is discussed. (Murphy-IVI)
W84-05233

WATER SODIUM AND BLOOD PRESSURE IN RURAL SCHOOL CHILDREN,
Medical Research Council, Harrow (England). Epidemilogy and Preventive Medicine.
B. K. Armstrong, B. M. Margetts, M. G. McCall, C. W. Binns, and N. A. Campbell.
Archives of Environmental Health, Vol. 37, No. 4, p 236-245, July-August, 1982. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Salinity, *Blood pressure, *Australia, Hypertension, Chemical properties, Biological magnification, Bioaccumulation.

Blood pressures were measured in 326 boys and 309 girls, 12 to 14 yr of age, who attended schools in six rural towns with water sodium levels ranging from 1.46 to 9.69 mmol/L. Although there were significant differences between mean blood pressure levels in children living in the six towns, they did not appear to result from differences in water sodium levels. Children who lived on farms and who drank low-sodium rain water did not have lower blood pressures than children who lived in the towns. The estimated intake of sodium from drinking water in the towns varied between 1.5 and 11.6 mmol/day and represented between 1.2% and 10.4% of the estimated daily sodium intake. No effect of water sodium level on urinary sodium excretion was found. Blood pressure levels showed significant positive relationships with pulse rate, body height and weight, Quetelet's index, midupperarm circumference, and triceps skinfold thickness. Diastolic blood pressures in girls were inversely related to a measure of physical activity. Control of these variables, where relevant, by covariance analysis did not uncover any relationship between water sodium level and blood pressure. (Author's abstract)
W84-05282

EPIDEMIOLOGICAL ASSESSMENT OF WATER QUALITY AND 'SWIMMER'S EAR',
Yale Univ., New Haven, CT. Dept. of Epidemiology and Public Health.
R. Calderon, and E. W. Mood.
Archives of Environmental Health, Vol. 37, No. 5, p 300-305, September-October, 1982. 1 Fig, 5 Tab, 28 Ref.

Descriptors: *Water quality, *Bacteria, *Swimmer's ear, Otitis externa, Epidemiology, Public health, Swimming.

In an effort to determine if bacterial water quality was related to the incidence of otitis externa (swimmer's ear), a retrospective study was conducted from July 1980 to September 1980. Data from 29 cases and 29 controls matched for age and sex were collected. The disease appears to be primarily associated with people less than 18 yr of age. Hot and humid ambient air appears to be associated with it. This association may be indirect rather than direct. Hot and humid air may determine the frequency and duration a person swims during periods of extreme weather. Swimming appears to be associated, but more important is the association with the quantity of time spent in the water swimming. Otitis externa does not appear to be associated with bacterial indicators of recreational water quality such as fecal coliforms, enterococci, or P. aeruginosa organisms. While P. aeruginosa may be the most commonly isolated organism from cases of otitis externa, the role of other bacterial etiological agents should not be excluded. (Baker-IVI)
W84-05283

NORWALK GASTROENTERITIS ASSOCIATED WITH A WATER SYSTEM IN A RURAL GEORGIA COMMUNITY,
Georgia Dept. of Human Resources, Atlanta. Office of Epidemiology.
R. A. Goodman, J. W. Buehler, H. B. Greenberg, T. W. McKinley, and J. D. Smith.
Archives of Environmental Health, Vol. 37, No. 6, p 358-360, November-December, 1982. 1 Fig, 9 Ref.

Descriptors: *Norwalk virus, *Water pollution effects, *Gastroenteritis, *Georgia, Coliforms, Viruses, Rainfall, Surface runoff, Public health, Water pollution sources, Springs.

An outbreak of acute gastroenteritis occurred during January 4-9, 1982, in a rural community in north Georgia. A systematic telephone survey revealed that 63% of the persons living in homes served by the community water system had symptoms of acute gastroenteritis in contrast to 9% of the persons in homes served by private wells or other sources. A fourfold rise in antibody titer to the Norwalk virus occurred in 20 of 22 serum pairs obtained from ill persons. Fecal coliforms were detected in a spring which served as one water source for the community system. Surface runoff from a heavy rainfall, which preceded the outbreak, may have contaminated the system. Inspection of the four sources in this system revealed two possible sites of contamination, including the spring in which fecal coliforms were detected. That spring was subject to contamination because its cover was in poor repair, the spring was open to ground water runoff from nearby homes with septic tanks and penned animals and to the excreta of several hogs that had direct access to the spring. In addition, the 2 inch polyvinyl chloride pipe, which carried water from this spring, was on the surface of the ground. Contaminated surface water may have entered the system through pipe joints loosened possibly by grazing animals or from freezing and thawing. The well casing of the single well was recessed below the ground level and had been exposed to flooding by surface water during unusually heavy rainfall. (Baker-IVI)
W84-05284

INFLUENCE OF COMBINED SEWAGE OUTFALL ON THE CHEMICAL AND BIOLOGICAL QUALITY OF SALT CREEK, PORTER COUNTY, INDIANA,
Indiana Univ. Northwest, Gary. Dept. of Biology.
R. L. Whitman.
Proceedings of the Indiana Academy of Sciences, Vol. 92, p 275-282, 1982. 4 Fig, 14 Ref.

Descriptors: *Wastewater outfall, *Water quality, Indiana, Porter County, Salt Creek, Salmon, Ammonia, Acidity, Nitrates, Phosphates, Sulfates, Chlorides, Sediments, Oxygen demand, Dissolved oxygen, Valparaiso.

Analyses of dissolved oxygen, specific conductance, pH, ammonia, nitrate, total phosphate, sulfate, chloride sediment oxygen demand and organic content and biological species diversity during July, August, September of 1980 and April of 1981 of Salt Creek waters indicated that the Valparaiso Combined Sewage Outfall (CSO) was the major contributor to the degradation of the stream's water and sediment quality. Little evidence of organic and sediment loading from agricultural practices was noted. Sand mining operations at the headwaters of Sager Creek above Sager Lake may significantly impact upstream ecosystems and potential salmon spawning areas. An undocumented sewage outfall between Horse Prairie Road and U.S. Highway 30 is strongly suspected although water quality data obtained here was inconsistent. In spite of heavy pollution imposed on the stream by these point sources, the stream at base flow conditions appeared capable of limited recovery about 9.0 to 12.6 km downstream of the Valparaiso CSO. The heaviest pollution, unfortunately, took place at stream locations with the greatest salmon spawning potential. Diurnal analyses indicated that episodes of significant rainfall coincided with anaerobic conditions in areas downstream of the Valparaiso CSO and with depressed oxygen levels as far north as the State Highway 6 station. Under these conditions of water quality, possible sediment loading from sand mining operations, and limited suitable spawning substrates, it is unlikely that Salt Creek's potential as a salmon fishery will improve. (Baker-IVI)
W84-05310

FISH DISTRIBUTION IN THE VICINITY OF BRUNNER ISLAND STEAM ELECTRIC STATION,
York Coll. of Pennsylvania. Dept. of Biological Sciences.
R. F. Denoncourt.
Proceedings of the Pennsylvania Academy of Science, Vol. 57, No. 2, p 165-172, 1983. 2 Fig, 3 Tab, 36 Ref.

Descriptors: *Fish, *Water pollution effects, *Powerplants, Cooling water, Seasonal variation, Brunner Island Steam Electric Plant, York County, Pennsylvania.

Three seasonal fish surveys were conducted in 1977-78 to determine relative abundance of fishes in the vicinity of Brunner Island Steam Electric

Station (BISES), York County, Pennsylvania. Emphasis was placed upon comparisons between control and stations affected by the cooling water discharge of this fossil fuel generating facility. A total of 43 fish species was found in the vicinity. Species number increased in winter at the affected stations with a decrease in diversity, percent similarity and Spearman Rank correlations in spring through summer. Winter diversity and abundance at affected stations was similar to spring and summer diversity at control stations. An obvious attraction/concentration occurred in winter within the warmer discharge waters followed by spring dispersal stimulated by preference, avoidance, natural migration and prey attraction. The August 1980 survey at five paired stations (experimental and control) showed reduced diversity in warmer waters close to the effluent source. Water temperatures, fish biomass, length frequencies and species diversity were similar by station sets 4 and 5 where percent similarities increaed and Spearman Rank correlations were significant. The data suggested fish community recovery or minimal effect between 6.6 and 11 km below the cooling water discharge. (Baker-IVI)
W84-05314

PRELIMINARY SURVEY OF POCONO MOUNTAIN LAKES TO DETERMINE SENSITIVITY TO ACID DEPOSITION,
Lehigh Univ., Bethlehem, PA. Dept. of Biology.
P. T. Bradt, and M. B. Berg.
Proceedings of the Pennsylvania Academy of Science, Vol. 57, No. 2, p 190-194, 1983. 5 Fig, 4 Tab, 14 Ref.

Descriptors: *Mountain lakes, *Acidity, Pocono Mountains, Pennsylvania, Lakes, Alkalinity, Drainage basins.

Ten lakes in the Pocono Mountain area of eastern Pennsylvania were sampled chemically in 1981 to determine their sensitivity to effects from acid deposition. The pH of precipitation in eastern Pennsylvania averages from 4.1 to 4.3. When acid precipitation falls on a lake with low alkalinity the pH of the lake may be decreased to a level at which fish, macroinvertebrates or algal populations may be reduced and/or altered. The ten lakes were located in Monroe, Pike, and Wayne counties, which are all underlain with insoluble bedrock. Each lake was small, in an undisturbed drainage basin, shallow, high altitude, having headwaters, in a low drainage basin area to lake surface area ratio, and natural or, if man made, at least 50 yr old. The pH of the lakes ranged from 4.6 to 7.0, total alkalinity from 0.0 to 210 microeq/l and conductivity from 11 to 41 microm hos/cm. Three of the lakes (Deep, Lacawac and Long) were chosen for study intensively, biologically and chemically for three years. All three lakes have available historical data, biological, chemical or both. These represent one acidified lake and two moderately sensitive lakes although Lacawac has a lower total alkalinity (45 microeq/l) than Long Pond (115 microeq/l). (Baker-IVI)
W84-05315

DIVERSITY, BIOTIC AND SIMILARITY INDICES, A REVIEW WITH SPECIAL RELEVANCE TO AQUATIC ECOSYSTEMS,
Commonwealth Scientific and Industrial Research Organization, Ryde (Australia). Div. of Fossil Fuels.
H. G. Washington.
Water Research, Vol. 18, No. 6, p 653-694, 1984. 5 Fig, 11 Tab. 98 Ref.

Descriptors: *Species diversity, *Bioindicators, *Water pollution effects, Ecosystems, Organic compounds, Stability analysis, Similarity indices.

Diversity Indices, Biotic Indices and Similarity Indices are reviewed with special consideration of their ecological application, both theoretical and practical. Eighteen diversity indices in eight groups, nineteen biotic indices in ten groups and five similarity indices are examined for their applicability to biological systems, particularly aquatic ecosystems. Biotic indices are highly specialized for a particular type of water pollution, usually organic pollution. In their present form, however, such indices are necessarily limited to the geographical area in which the tolerance lists were compiled. The five similarity indices examined have been used in aquatic systems. It is not clear which of these indices is best to use. While some appear better than others, there is a need for further research and field testing of similarity indices for water pollution. The relationship and definitions of diversity and stability are examined. Diversity does not automatically lead to either stability or instability but may be found with both. Disturbance to an ecosystem may often increase diversity provided it is of intermediate frequency, yet an ecosystem may also become more diverse without becoming less stable. It is urged that the use of inappropriate indices will be abandoned and concentration will be placed on indices which look promising to studying the effects caused by water pollution. (Baker-IVI)
W84-05316

EVALUATION OF THE RELATIVE IMPORTANCE OF FOOD AND WATER AS SOURCES OF P,P-DDT TO THE GOLDFISH, CARASSIUS AURATUS (L.),
Plymouth Polytechnic (England). Dept. of Environmental Sciences.
M. M. Rhead, and J. M. Perkins.
Water Research, Vol. 18, No. 6, p 719-725, 1984. 3 Fig, 1 Tab, 41 Ref.

Descriptors: *Pesticides, *Fish, Water pollution effects, Bioaccumulation, Organic compounds, DDT, Adsorption.

Goldfish were simultaneously exposed to p,p'-DDT from two sources, food and water, distinguishable unequivocally through the use of two radioactive labels. The concentration of DDT in food was maintained at about 1 microg/g while water concentration was 2, 20, or 177 ng/cu dm. The contribution of p,p'-DDT from food to the total body residue varied over the duration of the exposure from 0 to 81% at water concentrations of 2 ng/cu dm and from 3.8 to 4.8% for water concentrations about 171 ng/cu dm. The fish exposed to DDT-contaminated food and water simultaneously apparently accumulated p,p-DDT from the two sources additively. The importance of each source may be determined by its relative concentration over the period of exposure. The p,p'-DDT taken up by goldfish was converted, first slowly and then more rapidly to p,p'-DDE, reaching a maximum of over 80% from both water and food sources after about 40 days. Dietary p,p'-DDT was converted to p,p'-DDD to a greater extent than water-borne p,p'-DDT is converted to p,p'-DDD. (Baker-IVI)
W84-05318

SIMPLE, INEXPENSIVE IN SITU METHOD FOR ASSESSING ACUTE TOXICITY OF EFFLUENTS TO FISH,
Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
E. W. Wilde, and A. B. Parrott.
Water Research, Vol. 18, No. 6, p 783-785, 1984. 4 Fig, 1 Ref. U.S. Energy Dept. Contract No. DE-AC09-76SR00001.

Descriptors: *Fish, *Toxicity, Water pollution effects, Monitoring, Costs, Water analysis.

Test chambers for conducting in situ fish bioassays were constructed from 8 l. polyethylene bottles. Yearling fathead minnows and young-of-the-year bluegill demonstrated greater than 50% survival in the chambers after 65 days of exposure in a reservoir, river and creek. Fathead minnow survival was substantially greater than that of bluegills. The chambers provide a simple, inexpensive, sensitive technique to screen effluents for toxicity. The in situ method is more sensitive than laboratory methods in two respects: pulse discharges of toxic substances can easily be missed when effluent is collected in grab samples and transported to a laboratory for bioassay; and toxicants which dissipate rapidly, such as total residual chlorine, can be overlooked when there is a delay between collection and testing. (Baker-IVI)
W84-05324

STRATIGRAPHIC EVIDENCE OF EUTROPHICATION IN AN ESTUARY,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2L.
W84-05327

5D. Waste Treatment Processes

KDT INFORMATION CONFERENCE ON ECONOMIC EVALUATION OF REDUCTION OF THE WASTEWATER LOAD ON WATER RESOURCES (INFORMATIONSTAGUNG DER KDT ZUR OKONOMISCHEN BEWERTUNG DER ABWASSERLASTSENKUNG IN DEN GEWASSERN),
W. Schneider.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 149-152, May, 1983.

Descriptors: *Water management, *Wastewater treatment, *East Germany, *Economic aspects, Water use, Recycling, Waste recovery, Conferences.

The Economics of Water Management Committee of the KDT sponsored a conference on the economic benefits of wastewater treatment procedures as an integral constituent of rational water use. The goal of the conference was to aid in the implementation of the German Democratic Republic directive on rational water use within the 1981-85 five-year plan by demonstrating a method of determining the benefits of reducing the wastewater load and by developing ways of improving the effectiveness of water management techniques. The role of economics in planning and operating water management facilities is growing. Lectures were given at the conference on principles, methods, and examples of evaluating measures for reducing the wastewater load on water resources; wastewater purification in conjunction with river-system analysis; reviewing water-management procedures for implementing rational water use from the technological standpoint; evaluating wastewater load reduction and fulfilling societal needs with regard to wastewater quality; results of evaluation of wastewater load reduction in the Helme area; evaluation of operational procedures for rational water use from an industrial plants point of view, and experiences and results of an evaluation of the planned enlargement of the Cottbus municipal wastewater treatment plant. Recycling of valuable chemicals in wastewater is one important economic benefit brought out by the conference. (Gish-IVI)
W84-04794

EVALUATION OF OPERATIONAL PROCEDURES FOR THE IMPLEMENTATION OF RATIONAL WATER USE FROM THE POINT OF VIEW OF AN INDUSTRIAL PLANT (BEWERTUNG BETRIEBLICHER MASSNAHMAN FUR DIE DURCHSETZUNG DER RATIONELLEN WASSERVERWENDUNG AUS DER SICHT EINES INDUSTRIEBETRIEBES),
VEB Papier und Kartonwerke, Schwedt an der Oder (German D.R.).
For primary bibliographic entry see Field 3E.
W84-04796

PUBLIC HEALTH ASPECTS OF WATER REUSE,
LunDean Environmental Co., Cincinnati, OH.
R. B. Dean, and E. Lund.
Public Health Reviews, Vol. 11, No. 3, p 239-279, July-September, 1983. 162 Ref.

Descriptors: *Water reuse, *Public health, *Reviews, Organic compounds, Wastewater treatment, Water supply development, Water management, Epidemiology, Toxicology, Nitrogen, Salts.

Reuse of wastewater is not confined to a few special cases in which a community purifies and reuses its own sewage. The pollutants in wastewater are discussed in terms of their ability to cause disease and the efficacy of treatment processes to remove them. Evidence for adverse health

effects directly attributable to wastewater in water supplies is reviewed, and the conclusion is reached that existing techniques for purifying water appear to be able to control the demonstrable hazards. The inherent difficulties in setting standards based on epidemiological or toxicological data are discussed. The public health aspects considered include water borne infections. The evaluation of hazards and risks takes into account epidemiological evidence of both direct and indirect reuse as well as toxicological evidence. Health risks from chemical contaminants are discussed with specific mention being made of salts, nitrogen compounds, other inorganic substances, organic pollutants, and products of disinfection. Pathogens that may be present in fecally polluted water include bacteria, viruses, protozoa and helminths. Treatment methods discussed include both conventional and advanced treatments, soil treatment, the capability of water treatment to remove chemical pollutants, and the removal of pathogens. Microbial, physical, and chemical indicators for water quality control are considered. (Baker-IVI)
W84-04805

IDENTIFYING ENVIRONMENTALLY ACCEPTABLE LEAST-COST POLLUTION CONTROL SYSTEMS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
For primary bibliographic entry see Field 6B.
W84-04819

ROLE OF MICROORGANISMS IN THE DECOMPOSITION OF THE SUBSTANCES CONTAINED IN WASTE WATERS (DIE ROLLE DER MIKROORGANISMEN BEIM ABBAU VON ABWASSERINHALTSSTOFFEN),
Bundesanstalt fuer Wasserguete, Vienna (Austria).
W. Kohl.
Schweizerische Zeitschrift fur Hydrologie, Vol. 44, No. 2, p 204-215, 1982. 2 Fig, 5 Tab, 13 Ref.

Descriptors: *Microorganisms, *Wastewater, *Decomposition, Bacteria, Municipal wastewater, Oxygen balance, Wastewater renovation, Wastewater treatment, Biological wastewater treatment.

Ten short papers are summarized to develop an understanding of the role of microorganisms in the decomposition of wastewater. The following are the main points developed. After introduction of wastewaters from a sugar refinery, the total number of germs and the number of heterotrophic, enterobacteria, enterococci and pseudomonad colonies increase. Colibacilli, salmonellae and enterococci will multiply in waste waters that are warm and rich in nutrients, therefore wastewaters containing fecal matter and the wastewaters of the sugar refinery should not be discharged together. Waste waters with a low pH-value are bactericidal, so that they do not contain any saprophytes in spite of a KMnO4 consumption of 2700 mg/l. Below the municipal wastewater discharges, wastewater plumes are formed that can be up to several kilometers long. The heavily polluted tributaries have similar effects on the main river to those caused by wastewater discharges. In order to be able to better study the value of the data obtained from the analyses of myxobacteria, some waters were investigated for these bacteria; an average of 10-150 myxobacteria per mililiter was found. The possibility has been mentioned of using the ATP as an indicator for the microbial biomass. The results can be converted into carbon biomass or into the load in carbon biomass. The microbial decomposition of peptone in brackish water is similar to that occurring in fresh water, and the lag and log phases depend on the temperature. Laboratory analyses have shown that organic substances disturb the oxygen balance of a lake or a river, because they help dissimilation and inhibit assimilation. (Murphy-IVI)
W84-04909

EVALUATION OF CAIRO SEWAGE EFFLUENTS FOR IRRIGATION PURPOSES,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
M. El-Nennah, and T. El-Kobbia.
Environmental Pollution (Series B), Vol. 5, No. 4, p 233-245, 1983. 2 Fig, 4 Tab, 17 Ref.

Descriptors: *Wastewater irrigation, *Wastewater treatment, *Sewage effluents, Irrigation practices, Irrigation water, Irrigation efficiency, Wastewater management, Wastewater disposal, Land disposal, Heavy metals, Wastewater composition.

Samples of Cairo sewage effluents were collected over a 1-year period from two treatment plants and analysed for pH, electrical conductivity (EC), soluble cations and anions, N, P and trace elements, i.e. B, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn. Cairo sewage effluents contained much higher concentrations of soluble salts and trace elements than did tap water. This difference was more marked in effluent after primary sedimentation in El-Gabal El-Asfar than after mechanical sedimentation in the El-Zeinin treatment plant. No detectable heavy metals were obtained without acidic digestion, indicating the association of these metals with suspended solids in sewage effluents. The evaluation of sewage effluents was made on the basis of combination of EC and both sodium adsorption ratio (SAR) and soluble sodium per cent (of total soluble cations) (SSP), boron concentration and maximum permissible limits of heavy metals in irrigation water. Both Cairo sewage effluents are suitable for irrigation after primary sedimentation in El-Gabal El-Asfar and mechanical sedimentation in El-Zeinin but the concentration of heavy metals in the effluents used in irrigation should be controlled. Also, attention should be focused on the accumulation of heavy metals in soils and plants. (Murphy-IVI)
W84-04940

WATER IN POLYMER MEMBRANES. PART I, WATER SORPTION AND REFRACTIVE INDEX OF CELLULOSE ACETATE,
Agricultural Research Service, Albany, CA. Western Regional Research Center
For primary bibliographic entry see Field 3A.
W84-05048

REVIEW OF WATER POLLUTION PROBLEMS AND CONTROL STRATEGIES IN THE SOUTH AFRICAN MINING INDUSTRY,
For primary bibliographic entry see Field 5B.
W84-05087

LIME TREATMENT OF ACID MINE WATER AND ASSOCIATED SOLIDS/LIQUID SEPARATION,
Anglo American Research Labs., Crown Mines (South Africa).
D. J. Bosman.
Water Science and Technology, Vol. 115, No. 2, p 71-84, 1983. 3 Fig, 4 Tab, 4 Ref.

Descriptors: *Acid mine drainage, *Lime, *Wastewater treatment, Sulfates, Pyrite Iron, Sludge, Calcium sulfate, Iron hydroxide, Scale, Flotation, Settling.

Mine waters become contaminated to a varying degree with the oxidation products of pyritic materials associated with the minerals. Waters containing from 6000 to 13000 mg/L of sulfates and up to almost 5000 mg/L of iron are reported. For practical or economical reasons it is not yet possible to prevent this contamination of mine water. Prevention of pollution of surface water in South Africa is mostly confined to the neutralization of acid mine water with lime. The neutralization reaction results in the precipitation of a voluminous sludge containing mostly iron hydroxide and calcium sulfate, when the latter is formed in excess of its solubility in water. The sludge usually settles to volumes equal to 10% of the volume of the water treated, but volumes as high as 50% have been found. Through application of the 'High Density Sludge' process, which comprises sludge recirculation and conditioning with lime in addition to conventional neutralization and sedimentation, the volume of these sludges has been reduced to 0.4-2.0% of the volume of water treated. The seeding of calcium sulfate resulting in a reduction of scale build-up on plant equipment seems to be an advantage of the process. Dissolved air flotation was found an attractive alternative means of solids/liquid separation to gravity settling for water producing relatively low amounts of sludge (100 to 200 mg solids/L). At hydraulic loadings of 7 cu m/sq m/h (seven times higher than gravity settling) the flotation process produced an effluent containing less than 15 mg/L suspended matter and a sludge with a density of 50 g/L. (Author's abstract)
W84-05089

USING LIME TREATED ACID MINE WATER FOR IRRIGATION,
Soil and Irrigation Research Inst., Pretoria (South Africa). Dept. of Agriculture and Fisheries.
H. M. du Plessis.
Water Science and Technology, Vol. 15, No. 2, p 145-154, 1983. 5 Fig, 3 Tab, 14 Ref.

Descriptors: *Wastewater irrigation, *Acid mine drainage, Lime, Wastewater treatment, Crop yield, Permeability coefficient, Salt, Sulfate, Water pollution prevention.

The disposal of acid sulfate mine water poses a universal problem. Although water quality is much improved when neutralized by lime treatment, high salt loads nevertheless make release to better quality surface streams undesirable. The feasibility of using such water for irrigation was evaluated using a steady state chemical equilibrium model to product the composition of water draining from successive soil segments under a range of leaching fractions. Large amounts of gypsum are expected to precipitate in the soil profile resulting in a greater reduction in salinity than would occur if the water contained chloride instead of sulfate. A comparatively smaller reduction in crop yields can thus be expected and a greater variety of the marginally salt sensitive crops can be grown. The precipitation of gypsum however results in an increased sodium hazard to soil physical properties. This does not appear serious when evaluated against published data on soil hydraulic conductivity as affected by sodium and electrolyte concentration. A drastic reduction in the salt load in drainage from irrigated land compared to that in the applied water is predicted. Irrigation with lime treated acid mine water does not only seem feasible but also advantageous for the protection of water resources from mineral pollution. (Author's abstract)
W84-05091

USING ACID MINE WATER FOR REMOVAL OF PHOSPHATES FROM SEWAGE EFFLUENT,
Germiston Municipality (South Africa). Engineer's Dept.
P. H. van der Merwe, J. P. Maree, and N. D. Basson.
Water Science and Technology, Vol. 15, No. 2, p 155-167, 1983. 6 Fig, 5 Tab, 10 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Acid mine drainage, Acidity, Nitrification, Iron, Chemical reactions, Ammonia, Economic aspects.

An experiment was conducted at the Rondebult sewage purification works, regarding the use of underground mine water with a high iron content (617 mg/l of iron) for phosphate removal from sewage effluents, to comply with a limit of 1 mg/l soluble orthophosphates in the effluent. Orthophosphate precipitation with hydrolyzing cations is pH dependent which can be attributed to the solubility of the precipitates which form and the competition that exists between the hydoxide and orthophosphate ions for reaction with the cations. During the experimental period the average ammonia value for the raw sewage was 30 mg/l as N. Progressive removal of phosphate was achieved through the primary and secondary process stages resulting in a final concentration of 0.7 mg/l as P. When about 30 mg/l of Fe was introduced, ammonia N levels dropped to the order 3 to 4 mg/l. A significant improvement in the COD removal was also noted. A removal of approximately 84% of the iron was achieved. No significant change in the

volume of the secondary sludge has been noted. The method is both practical and economically attractive as an alternative for the chemical removal of phosphates in sewage works effluent. (Baker-IVI)
W84-05092

DRIP IRRIGATION OF COTTON WITH TREATED MUNICIPAL EFFLUENTS: I. YIELD RESPONSE,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
H. Bielorai, I. Vaisman, and A. Feigin.
Journal of Environmental Quality, Vol. 13, No. 2, p 231-234, April-June, 1984. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Drip irrigation, *Cotton, *Wastewater irrigation, *Crop yield, *Israel, Effluents, Municipal wastewater, Plant growth, Fertilizers, Irrigation efficiency, Irrigation water.

A long-term drip irrigation experiment was conducted on a grumusol (Typic chromoxerent) soil at Zor'a, Israel in 1978, 1979, and 1980 to study the influence of municipal effluent on the growth, yield, and line quality of drip-irrigated cottom (Gossypium hirsutum L.) var. 'Acala SJ-2.' Two sources of irrigation water were used: (i) municipal effluent and (ii) fresh water. The N concentration in the effluent was about 50 mg/L during the 3 years of experimentation. The treatments included three seasonal amounts of effluent and fresh water application: 350, 440, 515 min; and five levels of N: 0, 90, 150, 180, and 230 kg/ha (average of the 3 years), added to the fresh water only, via the drip system. The cotton plants irrigated with effluent grew taller, with more vegetative growth than did the plants irrigated with fresh water. The seed cotton yield obtained in 1978 was relatively low as a result of excessive vegetative growth and lodging of the plants. In the 1978 season, the seed cotton yield averaged 4.35 and 4.04 Mg/ha for the effluent and freshwater treatments, respectively. When growth was retarded in the 1979 and 1980 seasons by delaying irrigation and adjusting fertilizer management, average yields increased to 4.95 and 4.57 Mg/ha for the two water qualities, respectively. Lint percentage was 39.0 and 40.2 for the effluent and freshwater treatments, respectively. The lint quality, as determined by strength, length, and micronaire was the same for cotton irrigated with effluent as for cotton irrigated with fresh water. Municipal effluent can be used effectively as a source of irrigation water and plant nutrients, and with appropriate management, high production can be obtained. Drip irrigation increases irrigation and fertilization efficiency and minimizes ecological hazards. (Author's abstract)
W84-05115

DRIP IRRIGATION OF COTTON WITH TREATED MUNICIPAL EFFLUENTS: II. NUTRIENT AVAILABILITY IN SOIL,
Agricultural Research Organization, Bet-Dagan (Israel). Volcani Center.
A. Feigin, I. Vaisman, and H. Bielorai.
Journal of Environmental Quality, Vol. 13, No. 2, p 234-238, April-June, 1984. 5 Fig, 3 Tab, 16 Ref.

Descriptors: *Wastewater irrigation, *Drip irrigation, *Cotton, Effluents, Fertilizers, Nitrogen, Phosphorus, Potassium, Leaching, Municipal wastewater.

The suitability of sewage effluent for drip irrigation of cotton (Gossypium hirsutum) growing on a deep calcareous clay soil (Typic Chromoxererts) was studied during three seasons. Secondary effluent was compared with freshwater at three application rates, the average of which for the three seasons were: low (350 mm/yr), standard (440 mm/yr), and high (515 mm/yr). Fertilizer was applied with the fresh water in order to deliver amounts of nutrients (average for the 3 years) equivalent to those in the effluent that contained 150, 180, and 230 kg N; 32, 37, and 46 kg P; and 80, 100, 120 kg K/ha/yr for the three rates, respectively. In addition, the standard amount of fresh water was given with half the quantity of fertilizer, and without fertilizer. The concentration of available N and P in soil was increased greatly in all effluent and fertilizer-amended freshwater treatments, while available K in the soil was increased to a lesser extent. In general, at equivalent application levels, no significant differences in the level of available N, P, and K in the soil or in their uptake by plants, were detected between effluent and fertilizer-amended fresh water, although dry matter yield as well as N, P, and K accumulation were greater in the high-application-rate effluent treatment. The distribution of NO3-N in the soil profile was controlled by drip irrigation and practically no build-up of NO3(-) was detected below the 0- to 0.6-m depth layer during the irrigation period (in summer). However, during the rainy, winter season, heavy losses of residual NO3-N occurred probably mainly through leaching. (Author's abstract)
W84-05116

QUALITY OF PERCOLATE WATER AFTER TREATMENT OF A MUNICIPAL WASTEWATER EFFLUENT BY A CROP IRRIGATION SYSTEM,
Agricultural Research Service, St. Paul, MN.
D. R. Linden, C. E. Clapp, and W. E. Larson.
Journal of Environmental Quality, Vol. 13, No. 2, p 256-264, April-June, 1984. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Wastewater irrigation, *Land application, Wastewater renovation, Crop management, Corn, Grasses, Nitrogen removal, Phosphorus removal, Potassium, Sodium, Chloride, Percolating water.

Crop management effects on the renovation of municipal wastewater effluent were studied in a 6-year field experiment. A randomized split-plot block design was used, with corn (Zea mays L.) and forage grasses (reed canarygrass, Phalaris arundinacea L.) as crops and effluent application rates of none, approximately 0.05, and 0.10 m/week. Nitrogen, phosphorus, potassium, sodium, and chloride were measured in percolating soil water during 5 years under corn and 3 years under forage grasses to assess the quality of renovated wastewater. Nitrogen concentrations were generally below 10 mg/L, with total applications ranging between 200 and 970 kg N/ha/year. Nitrogen concentrations also were consistently lower under effluent treatments as compared with fertilized controls and lower under forage crops than under corn. Nitrogen levels increased significantly with increased application rates, especially under corn crops and only occasionally exceeded 10 mg/L during early and late season when applications surpassed crop uptake demands. Low P concentrations (< 0.05 mg/L) in percolate water verified nearly complete removal by the soilcrop system except during the final 2 years under corn when concentrations increased about fivefold to 0.7 mg/L. Potassium levels suggested a continuing removal from the effluent. Sodium and chloride concentrations began at low levels and increased during the first 1 to 2 years of irrigation until they approached the concentration of the effluent. These results indicate that high N demand crops such as forage grasses have the potential for better renovation of effluent than corn at high application rates, but at lower rates corn will renovate effluent to acceptable N concentrations. (Author's abstract)
W84-05119

PREDICTION OF PHOSPHATE MOVEMENT THROUGH SOME SELECTED SOILS,
Norsk Inst. for Skogforskning, Aas.
A. O. Stuanes, and C. G. Enfield.
Journal of Environmental Quality, Vol. 13, No. 2, p 317-320, April-June, 1984. 2 Fig, 3 Tab, 25 Ref.

Descriptors: *Phosphates, *Land disposal, *Soil water, *Solute transport, Soil chemistry, Mathematical models, Wastewater treatment, Sorption, Equilibrium isotherms.

The P sorption capacity of soils must be evaluated at land application wastewater sites when water quality criteria control the design of the treatment system. The soil's capacity to react with P is often underestimated when equilibrium isotherms are used to describe P sorption. An analytical one-dimensional convective dispersive solute transport model, assuming linear sorption and first-order irreversible precipitation, was evaluated to describe the movement of P in small laboratory columns. The model was calibrated to experimental data using nonlinear least squares analysis. The length of the column did not make a significant difference in the model coefficients. This finding suggests that the approximation of a linear sorption isotherm with first-order irreversible precipitation is adequate for making environmental assessments at land-treatment systems. Application of the model to the design of a land-treatment system would permit approximating a system life considering wastewater application rate, concentration of P in the applied water, and travel distance through the soil profile prior to discharge. Experimental data fit to a Langmuir equation using the same soils were found to seriously underestimate the capacity of soil to react with P. The same data fit to a Freundlich or other equilibrium isotherm would yield similar results. It was concluded that use of equilibrium isotherms without considering the kinetics of the reactions will lead to overly conservative designs of land application of wastewater treatment systems. (Author's abstract)
W84-05124

CHEMICAL ASPECTS OF THE LIME SEAWATER PROCESS,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. F. Ferguson, and L. Vrale.
Journal of the Water Pollution Control Federation, Vol. 56, No. 4, p 355-363, April, 1984. 13 Fig, 3 Tab, 8 Ref.

Descriptors: *Wastewater treatment, *Clarification, *Lime, *Seawater, Hydrogen ion concentration, Coliforms, Phosphorus, Sludge.

The use of seawater makes lime treatment of wastewater more effective by improving suspended solids and phosphate removal. The lime seawater process is capable of producing an effluent suitable for marine discharge if no more than 75% soluble BOD removal is required. Removal of suspended solids and phosphorus is characterisically greater than 90%. The effluent is very clear. Seawater adds enough magnesium to precipitate at least 0.6 millimoles/L of magnesium hydroxide. The amount of seawater needed depends, therefore, on the solubility of magnesium hydroxide, which is a function of pH. As little as 1 to 2% seawater is needed if pH values above 11 are used; if pH values are below 1.5, 10% or more seawater will be required. Phosphate solubility is seldom limiting in the process, but can be described as a function of pH and calcium concentration. At pH values below 10.5, orthophosphate is a significant portion of the total phosphate. Sludge recycle improves the steady-state performance of the process. At lime dosages of 165 and 240 mg/L, effluent turbidity was reduced by 30 to 50% by sludge recirculation. (Baker-IVI)
W84-05142

ACCLIMATION OF ACTIVATED SLUDGE TO PENTACHLOROPHENOL,
Camp, Dresser and McKee, Inc., Annandale, VA.
G. T. Hickman, and J. T. Novak.
Journal of the Water Pollution Control Federation, Vol. 56, No. 4, p 364-368, April, 1984. 9 Fig, 13 Ref.

Descriptors: *Activated sludge process, *Acclimation, *Pentachlorophenol, Dextrose, Metabolism, Microorganisms, Toxicity, Shock loads, Priority pollutants.

The ability of activated sludge to withstand shock loads of priority pollutants was investigated. The degree of metabolic activity of the activated sludge was measured in terms of its specific rate of dextrose uptake. Almost a month was required for the municipal activated sludge to completely adjust to using dextrose. The apparent maximum specific uptake rate is roughly in the range of 0.30 to 0.35/hr. The SUR test was adequate to assess the inhibition of activated sludge. Introducing a low level of pentachlorophenol (PCP) to the activated sludge

process can offer protection from shock loads of PCP. The amount of protection afforded is directly related to the acclimation concentration. Acclimation of activated sludge to PCP also provides protection from shock loads of related priority pollutants. Complete removal of the introduced PCP was accomplished during the study, but was not maintained. The specific uptake rate procedure is a rapid, easy method of assessing the relative inhibition of toxic chemicals to activated sludge. (Baker-IVI)
W84-05143

PROCESS FOR THE REMOVAL OF ORGANIC HAZARDOUS MATERIAL FROM WASTE WATER (VERFAHREN ZUR ENTFERNUNG ORGANISCHER SCHADSTOFFE AUS ABWASSER),
Didier-Werke A.G., Konigswinter (Germany, F.R.).
H. Bender.
Wasserwirtschaft, Vol. 73, No. 3, p 71-75, 1983. 5 Fig.

Descriptors: *Wastewater treatment, *Organic matter, *Hazardous material, Heavy metals, Toxicity, Polymer resins, Water quality, Pollution load.

The efficient determination of heavy metals and organic matter in wastewater is necessary for an effective wastewater treatment process. The removal of toxic organic matter by adsorption to special polymer resins is presented as a new process. A degree of purity of less than 1 mg hazardous material per liter of treated waste water with a high specific pollution load can be achieved. The polymer resins and the process equipment allow various regeneration techniques. (Murhy-IVI)
W84-05234

GRADUAL DEVELOPING OF THE SEWAGE SYSTEM OF A CELLULOSE- AND PAPER-MILL AND FEEDBACK ON WATERQUALITY OF A RIVERSYSTEM (STUFENWEISER AUSBAU DER ABWASSERREINIGUNG EINER ZELLSTOFF-KARTONFABRIK UND SEINE RUCKWIRKUNG AUF DIE WASSERGUTE DER VORFLUTER),
Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Biologie.
O. Klee.
Wasserwirtschaft, Vol. 73, No. 6, p 183-189, June, 1983. 10 Fig, 10 Ref.

Descriptors: *Wastewater management, *Water quality control, Industrial wastewater, Wastewater disposal, Wastewater facilities, Wastewater treatment.

In the span of 24 years wastewater treatment facilities have improved and so have treatment facilities of a cellulose- and paper mill. The Schussenstream along with its tributary, the Wolfegger Ach has had increased water quality in recent years. With the use of systematic sewage and effluent treatment by the local treatment plant the resulting effluent has improved so as to develop better water quality in the surrounding outfall areas. The development of improved treatment facilities was gradual but the results have warrented its implementation. (Murphy-IVI)
W84-05243

DIMENSIONING OF SURPLUS DISPOSAL WORKS WITH APPROXIMATION METHODS AND STORMWATER QUALITY MODELS (BEMESSUNG VON REGENENTLASTUNGEN MITTELS NAHERUNGSVERFAHREN UND SCHMUTZFRACHTMODELLRECHNUNGEN),
Bayerisches Staatsministerium des Innern, Munich (Germany, F.R.). Oberstem Baubehoerde.
A. Gottle, and H. Weis.
Wasserwirtschaft, Vol. 73, No. 9, p 298-303, 1983. 3 Fig, 8 Ref.

Descriptors: *Wastewater disposal, *Stormwater, *Model studies, Wastewater treatment, Water quality, Rainfall distribution, Sizing, Empirical methods, Deterministic methods.

Questions of the contamination of the receiving water and an optimized storm water treatment can be met only by means of quality models considering the real time series of the rainfalls as input. The design methods used in the procedure are compared. The methods can be divided into two groups: empirical methods, and deterministic measurement methods. The process of rainwater quality modeling for combined wastewater systems is dependent on deterministic methods. Empirical methods should not be incorporated in modelling processes. (Moore-IVI)
W84-05253

RHINE - PRIORITY FOR DRINKING WATER (AM RHEIN - VORRANG FUR TRINKWASSER),
K.-G. Malle.
Wasser, Luft und Betrieb, Vol. 27, No. 5, p 16, May 1983.

Descriptors: *Water quality standards, *Drinking water, *Rhine River, Water pollution effects, *Water pollution control, Conferences, Symposium, Water quality management.

The proceedings of the Ninth Conference of the International Study Group of Waterworks in the Rhine Catchment Area, held from 11 to 13 April 1983 in Cologne, Federal Republic of Germany, are briefly described. Focal point of the conference for drinking water experts was a discussion of problems with producers of wastewater discharge into the river. Modern column biology wastewater treatment facilities in Leverkusen and in the Wupper valley and the major municipal facility for Cologne in Stammheim were inspected. A panel discussion on the effectiveness of wasewater treatment facilities and future treatment goals included representatives of a municipal facility, the chemical and paper industries, and a waterworks facility. Subjects for discussion were furnished by Professor Sontheimer in his lecture 'Requirements for Wastewater Treatment in Light of New Developments in Rhine Water Quality.' He presented five theses: increased removal from the Rhine of matter that can be broken down easily by biological means is unnecessary (this was rejected as it was agreed that treatment of the lower Main and other polluted tributaries should continue); further removal of nitrogen and phosphorus compounds from wastewater has little significance for the Rhine (this met with strong protest from the Netherlands, while Sontheimer countered that concentrations low enough to reduce eutrophication in Netherlands lakes were impossible to achieve and suggested phosphate precipitation in lake inflows); group parameters like total organically bound sulfur rather than summed parameters or individual chemical analysis such as 5-day BOD which should be used to assess the quality of treated wastewater (it was agreed that all three have their place and that it would be a mistake to concentrate on a ever-increasing number of individual analyses); the immission rather than the emission situation is the deciding factor for drinking water quality, and adapting emission to water flow could be considered (water authorities disagreed, as their emphasis has been on emission); further development of wastewater treatment should concentrate on new methods rather than enlarging existing plants. (Gish-IVI)
W84-05272

HARDSHIP REGULATIONS OUTSIDE SECTION 9, PARAGRAPH 6 OF THE WASTEWATER TAX LAW (HARTEREGELUNGEN AUSSERHALB DES SEKTION 9 ABS. 6 ABWAG),
H. Keune.
Wasser, Luft und Betrieb, Vol. 27, No. 5, p 22-25, May 1983. 43 Ref.

Descriptors: *Wastewater tax law, *Water law, *Pollution taxes, Tax rate, Payment,.

The Federal Republic of Germany does not allow deductions to the user in cases of hardship. However, state laws do allow such applications for delay in payment and reductions in wastewater tax. A delay is permitted when immediate payment would result in severe hardship for the taxpayer and there would be no jeopardy to the authority's claim. Partial payment may be required for a tax cancellation, no appeal by the taxpayer is necessary. This usually occurs when it is obvious that payment cannot be made or when the cost of collection would be disproportionate to the amount collected. However, the tax claim is not deleted, and other measures against the taxpayer may be instituted. In one case of a tax reduction, part of the claim is deleted; this usually occurs if total payment would result in severe hardship, such as plant closure. Interest payments or late fines on wastewater taxes cannot be delayed or reduced. The states are obliged to refund taxes if a company pays too much; however there is no interest paid on the refund, so these should be avoided. Some states require prepayment of taxes, based on an estimate, the setting of one prepayment amount comes with the proviso that the estimate will be verified. As long as the proviso is in effect, the company may appeal the prepayment amount required. The authorities are legally bound to hear such appeals. The authorities are of the opinion that taxes should be paid on time even in the case of an appeal, but a Darmstadt court rejected this notion in 1982, so that taxes need not be paid until a decision is reached. Portions of the tax not in dispute should be paid to avoid interest payments. Money can be saved if a company informs the authorities when they expect a reduction in operation resulting in a reduction in wastewater discharged - as long as this will last at least 3 months with at least a 25% reduction in wastewater. In this case, taxes will be assessed on the new level of operation. (Gish-IVI)
W84-05273

MECHANICAL EXTRACTION DEVICES FOR MAXIMAL-LOAD ACTIVATED-SLUDGE STAGES (MASCHINELLE RAUMEINRICHTUNGEN FUR HOCHSTLASTBELEBUNGSSTUFEN),
L. Finkelmann.
Wasser, Luft und Betrieb, Vol. 27, No. 6, p 17-20, June 1983.

Descriptors: *Activated sludge process, *Wastewater treatment, *Mechanical extraction, *Pollution load, Activated sludge, Wastewater Renovation, Sludge conditioning, Sludge digestion, Sludge.

Multistage biological wastewater treatment facilities are gaining in importance, but are expensive to build and operate, so that ways to improve the cost:performance ratio are being sought. The use of a mechanical extractor to return activated sludge from the intermediate treatment stage to the activation tank is described in the case of the adsorption-activation procedure employed by the Rheinhausen and Rheinberg facilities, Federal Republic of Germany. After mechanical treatment, the wastewater enters a two-stage, and the second of which is the recycling, lowload stage. In the activation tank during the maximal-load stage, physical and biological adsorption and flocculation processes occur as well as biological degradation. In order to maintain maximal load (i.e., high nutrient supply), the amount of sludge is kept low by removing excess, while its load is kept high. The wastewater flows out around the perimeter of the activation tank into the ring-shaped intermediate treatment facility, where it is aerated and dewatered before activated sludge is returned to the second stage. Studies have shown that a fast return of activated sludge from the intermediate stage to the activation tank is important, and this can be achieved by means of a mechanical extractor that spans the entire basin and constantly circles. It is constructed as a double extractor with three underwater pumps on each side to convey sludge via two grooves on the extractor bridge back to the tank. Settled sludge is thereby removed in 20 min. In Rheinhausen, up to 720 cu m sludge/hr can be returned to the tank per groove. Advantages of this procedure are short total aeration time, low electricity use, full utilization of the cleansing power of the activated sludge, constant supply of

strongly activated sludge in the second biological stage, and stable, even performance. (Gish-IVI)
W84-05274

PREVENTION OF ORGANIC DEPOSITS AND MICROBIAL CONTROL IN INDUSTRIAL COOLING WATER SYSTEMS (VERHINDERUNG ORGANISCHER ABLAGERUNGEN UND MIKROBIELLE KONTROLLE IN INDUSTRIELLEN KUHLWASSERSYSTEMEN),
H. Schmidt.
Wasser, Luft und Betrieb, Vol. 27, No. 9, p 12-17, September 1983. 9 Fig, 9 Ref.

Descriptors: *Organic deposits, *Microbial control, *Cooling water, Industrial water, Water pollution control, Nuisance algae, Water quality control, Water pollution treatment, Chlorination, Biological wastewater treatment, Wastewater treatment, Pressure filters, Gravity filters.

The combined application of chlorine and biological dispersal agents (based on polyalkyl glycols) is effective in the control of microorganisms in industrial cooling water systems and is favorable both economically and ecologically. Such nonionic dispersal agents allow effective penetration of chlorine in the form of hypochloric acid (HOCl), which is most effective as a free acid, so that water pH must be < 7.5. However, pH < 7 is to be avoided in order to prevent corrosion. Chlorine is applied in gas form directly to the water through a dosage device. Useful compounds are sodium hypochlorite and di- and tri-chlorine isocyanurate. In order to control the number of microorganisms in cooling water and to prevent deposits thereof that hinder heat transfer, continuous application of the biological dispersant at a concentration of 5-30 ppm (depending on system type, number of microorganisms and nutrient supply) is effective. This is combined with regular (1-3 times/day), discontinuous application of Cl2 or NaOCl in an amount that causes a 0.5-1.0 ppm excess in free Cl2 in the cooling water return flow. Dispersant application is achieved by means of a dosage pump controlled by the volume of added water. To combat a preexisting infestation, the chlorine-dispersant combination is applied in alternating discontinuous doses in a concentration of up to 1,000 ppm dispersant. This concentration must be maintained for 24-72 hr, during which time sludge should be removed, beginning at a slow rate and then increasing. A more frequent backflushing of partial-flow filters will be necessary. This procedure can also be used to remove biomass from pressure and gravity filters. (Gish-IVI)
W84-05275

NOVEL METHOD FOR STUDYING THE PUBLIC HEALTH SIGNIFICANCE OF MACROINVERTEBRATES OCCURRING IN POTABLE WATER,
Worcester Polytechnic Inst., MA. Dept. of Biology and Biotechnology.
R. V. Levy, R. D. Cheetham, J. Davis, G. Winer, and F. L. Hart.
Applied and Environmental Microbiology, Vol. 47, No. 5, p 889-894, May, 1984. 6 Fig, 25 Ref. NIH grant RR07198-01, EPA grant CR810241-01-0.

Descriptors: *Macroinvertebrates, *Potable water, *Monitoring, Chlorine, Disinfection, Microbiological studies.

An experimental procedure was developed to study the association of selected bacteria and macroinvertebrates and their response to free available chlorine disinfection. The organisms selected for study were Escherichia coli (LacZ545), Enterobacter cloacae (ATCC23355), and the amphipod Hyalella azteca. E. coli was shown to bind tightly (16,000 CFU per amphipod) to this macroinvertebrate and to resist repeated attempts to wash it off. E. cloacae was shown to bind much less tightly (1,400 CFU per amphipod) to H. azteca and was less resistant to removal by washing. The extent of association is a function of macroinvertebrate size (surface area), but the procedure produces repeatable results usable for controlled experimentation. This method, together with the dual bacterial identification criteria (morphology and antibiotic resistance), was used to study the response of unassociated and associated E. coli and E. cloacae to disinfection with free available chlorine at 1.0 mg/liter. Unassociated E. coli populations decreased to less than 1% of their zero time controls within 1 min of contact time, whereas more than 2% of the associated E. coli populations remained viable after 60 min of contact at 1.0 mg of free available chlorine per liter. Unassociated E. cloacae populations decreased to less than 1% of their zero time controls within 1 min of contact time, whereas ca. 15% of the associated E. cloacae populations remained viable after 60 min of contact at 1.0 mg of free available chlorine per liter. With minor modifications this method can be used to study essentially any combination of bacterium and macroinvertebrate and to thereby ascertain whether a macroinvertebrate can serve to breach the chlorine disinfection barrier, protect potential bacterial pathogens from disinfection, and possibly allow for subsequent pathogen multiplication within a potable water distribution system. (Author's abstract)
W84-05276

REMOVAL OF ENTERIC VIRUSES FROM SURFACE WATER AT EIGHT WATERWORKS IN THE NETHERLANDS,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
M. van Olphen, J. G. Kapsenberg, E. van de Baan, and W. A. Kroon.
Applied and Environmental Microbiology, Vol. 47, No. 5, p 927-932, May, 1984. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Enteric viruses, *Surfaces water, *Waterworks, *Netherlands, Microbiological studies, Water sampling, Water quality, Rhine River, River Drentse, River Meuse, Lake Haringvliet, Lake IJsselmeer, Bacteriophage, Bacterial analysis, Human enteroviruses.

Increased demands on surface water for the preparation of drinking water are combined with continuing pollution of these resources by sewage. Eight waterworks in The Netherlands, which use surface water as their raw water source, were sampled repeatedly between November 1978 and June 1981. Sampling took place on the Rhine River, River Drentse, River Meuse, Lake Haringvliet, Lake IJsselmeer and from surface water in Westland. At five waterworks, 30 of 45 samples of raw water contained viruses. Of 55 samples of partially purified water, 11 were virus positive, including 8 after coagulation, sedimentation, and rapid sand filtration, 2 after storage, coagulation, sedimentation, transport chlorination, and rapid sand filtration, and 1 after storage in open reservoirs for 5 months. No viruses were detected in 100 samples of drinking water of 500 liters each from six waterworks. Most isolated viruses were typed, and a great variety of human enteroviruses were found, reflecting both pollution of raw water sources with sewage and vaccination with oral polio vaccine in neighboring countries. (Murphy-IVI)
W84-05277

INFLUENCE OF WATER QUALITY ON ENTERIC VIRUS CONCENTRATION BY MICROPOROUS FILTER METHODS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, and J. S. Glass.
Applied and Environmental Microbiology, Vol. 47, No. 5, p 956-960, May, 1984. 4 Tab, 18 Ref. EPA grant R806677.

Descriptors: *Enteroviruses, *Polioviruses, *Echoviruses, *Reoviruses, *Adenoviruses, *Water quality, *Filtration, *Microporous filters, Wastewater treatment, Biological properties.

Four enteric viruses, poliovirus type 1, echovirus type 1, reovirus type 3, and simian adenovirus SV-11, were concentrated from seeded 1.3-liter volumes of raw, finished, and granular activated carbon-treated waters by adsorption to 47-mm-diameter (17 sq cm), electropositive (Virosorb 1MDS) filters at pH 7.5 or electronegative (Filterite) filters at pH 3.5 with and without 5 mM added MgCl2, followed by elution with 0.3% beef extract in 50 mM glycine at pH 9.5. Removal of particulates from raw and finished waters by 0.2 micro m prefiltration before virus addition and pH adjustment had little effect on virus concentration efficiencies. Soluble organic compounds reduced virus adsorption efficiencies from both raw and finished waters compared with granular activated carbon-treated water, but the extent of interference varied with virus type and adsorption conditions. For electropositive 1MDS filters, organic interference was similar with all virus types. For Filterite filters, organic interference was evident with poliovirus and echovirus, but could be overcome by addig MgCl2. Reovirus and SV-11 were not adversely affected by organics during adsorption to Filterite filters. Elution of reovirus and adenovirus was inefficient compared with that of poliovirus and echovirus. None of the three adsorption schemes (1MDS at pH 7.5 and Filterite with and without 5 mM MgCl2 at pH 3.5) could be judged superior for all viruses and water types tested. (Author's abstract)
W84-05278

STUDIES OF THE HALOGENATION OF DISSOLVED ORGANIC MATERIAL DURING THE CHLORINATION OF SALINE COOLING WATERS, USING THE MODEL COMPOUND RESORCINOL,
Southampton Univ. (England). Dept. of Chemistry.
A. G. Howard, R. A. Pizzie, and J. W. Whitehouse.
Water Research, Vol. 18, No. 6, p 735-743, 1984. 6 Fig, 3 Tab, 36 Ref.

Descriptors: *Chlorination, *Saline water, Cooling waters, Resorcinol, Halogenation, Dissolved organic matter, Haloforms, Trihalomethanes, Bromide, Chemical reactions, Chlorine.

With a view to highlighting differences between the chlorination reactions occurring in fresh and marine waters, a study of halogenation reactions occurring during the chlorination of saline waters was undertaken. Chlorination of resorcinol in seawater with sodium hypochlorite resulted in the formation of 17 products. The variety of reaction products formed is controlled by competing equilibria involving chlorination of the resorcinol and conversion of oxidizing species to hypobromous acid by exchange with naturally occurring bromide. When bromide is present in a molar excess over added chlorine, chlorination of resorcinol is only favored under high pH conditions. Under more acid conditions however, bromination occurs at the expense of chlorination. Increasing chlorine levels leads to ring cleavage and the production of trihalomethanes, haloforms. (Baker-IVI)
W84-05320

AUTOTROPHIC NITRATE DISSIMILATION USING SODIUM THIOSULFATE (AUTOTROPHE NITRATDISSIMILATION DURCH EINSATZ VON NATRIUMTHOSULFAT),
Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
H. Bohme, and D. Dieneck.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 160-163, May, 1983. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Nitrates, *Nitrogen removal, *Sodium thiosulfate, Drinking water, Water treatment, Chemical treatment, Water quality, Water quality control.

Experiments on the use of sodium thiosulfate to remove nitrate from drinking-water reservoirs in the German Democratic Republic (GDR) are described. Since 1960, nitrate levels in surface waters in the GDR have increased due to the intensification of agriculture. It was hoped that costs would be reduced by removing nitrates in the reservoir rather than by ion exchange at the water treatment plant. The autotrophic procedure was environmentally preferable to the heterotrophic, which requires the addition of carbon sources. Laboratory experiments were conducted to observe the auto-

trophic process and were used as a base for practical applications. One hundred tonnes (t) Na2S203.5H20 was introduced in two 50-t steps into the hypolimnion of an area of a drinking water reservoir in the GDR measuring 19.9 ha and with a volume of 3.1 million cu m (0.92 million cu m hypolimnion). The chemical was dissolved in a neighboring quarry and was introduced into the reservoir by means of a hose leading to a floating pipeline, which passed through a raft towed by a boat. A pump dispersed the chemical, diluted to 150 cu m/step, in 5-6 hr. Laboratory studies showed that nitrate dissimilation began only with oxygen levels of < 2 mg/l, so that a large portion of the first dose would be used to reduce oxygen levels. It was calculated that 9.22 t 02 had been removed by 35.7 to Na2S203.5H20, so that nitrate elimination began in earnest with the second application. A total of 16 t NO3(-) was transformed into elemental nitrogen. In late summer 1980, 450 t Na2S203.5H20 was introduced into an auxiliary reservoir of a GDR drinking-water reservoir with a volume of 23.1 million cu m (4.9 million cu m hypolimnion). A 30% solution of the chemical was prepared in a specially constructed tank and dispersed within 6 days in the hypolimnion by means of a 1,500-m pipeline, which snaked back and forth diagonally to the dam. A total of 10.8 t oxygen and 160 t NO3(-) was eliminated, demonstrating an overdosing of Na2S203.5H20 due to a previous heterotrophic NO3(-) procedure. The cost of the procedures using the latest technology is 2.23 Marks/kg NO3(-) eliminated, compared with 9-30 Marks/kg for the ion-exchange method. (Gish-IVI)
W85-04798

WATER CHEMISTRY AND THE ECONOMY OF RAW MATERIALS (WASSERCHEMIE UND STOFFWIRTSCHAFT),
Technische Univ., Dresden (German D.R.). Sektion Verabeitungs- und Verfahrenstechnik.
M. Schubert, and J. Kaeding.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 174-176, May, 1983. 2 Fig, 3 Ref.

Descriptors: *Water chemistry, *Optimum development plans, Water use, Water reuse, Water resources development, Energy, Wastewater treatment.

Efforts to optimize limited water resources in industrialized countries, particularly the German Democratic Republic (GDR), have led to wastewater-treatment techniques that concentrate on achieving high water quality in the receiving stream, whereby only the raw material water is subject to multiple use. Rational water use demands the reutilization of other raw materials. Recently the Socialist Unity Party of Germany called for the creation of closed cycles for raw materials, and both COMECON and the UN have recommended development of a 'garbage (waste-product)-free technology.' However, it is not enough to institute recycling within an individual product line; the concept must be carried over into all industrial and consumer areas. The goal of such an economy is the mutual exchange of energy and raw materials between society and the environment. For municipal wastewater, this might include the concepts of wastewater as raw material (sludge used for chemical synthesis, reclamation of nutrients like phosphorus, use of organic dry matter as soil conditioner); direct energy gain (by installing a heat pump at the outlet of a wastewater facility, thermal energy released in biochemical metabolism); energy conservation at the treatment plant through improved aeration for the activated-sludge procedure and substitution of anaerobic for aerobic treatment; and metabolic procedures to create new forms of energy (methane gas production by sludge and surface-water digestion, wet oxidation and incineration/pyrolysis of biological sludge). Collection of comprehensive data on wastewater through water chemistry, introduction of new types of bacteria through hydrobiology, and research into new wastewater-treatment techniques are essential, as is the education of scientists and engineers in the closed-cycle principle. The GDR, together with the Hungarian Peoples Republic, prepared a handbook on waste-product-free technology for the UN to aid in the evaluation of such procedures. Such international cooperation is considered important in the peace policy of socialist countries. (Gish-IVI)
W85-04802

5E. Ultimate Disposal Of Wastes

METHODOLOGIES TO PREDICT THE MOBILITY AND AVAILABILITY OF HAZARDOUS METALS IN SLUDGE-AMENDED SOILS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W84-04886

LAND USE OF WASTEWATER AND SLUDGE,
Nolte (George S.) and Associates, Sacramento, CA.
R. W. Crites.
Environmental Science and Technology, Vol. 18, No. 5 p 140A-147A, May, 1984. 2 Fig, 4 Tab, 49 Ref.

Descriptors: *Municipal wastewater, *Land application, Public health, Sludge disposal, Spray irrigation, Wastewater treatment, Trace metals, Phosphorus, Nitrification, Biochemical oxygen demand, Infiltration, Soil properties, Reviews, Suspended solids.

A review of current technologies, treatment performance, and research needs for the use of municipal wastes is offered. The three land treatment processes for wastewater are slow rate, rapid infiltration, and overland flow. Slow rate land treatment is the controlled application of wastewater by sprinkler or surface means to a vegetated land surface. Rapid infiltration is the application of wastewater to permeable soils, such as sands or sandy loams, for treatment in shallow spreading basins. Overland flow is a fixed-film biological treatment process by which wastewater is applied at the upper portions of grass-covered slopes and allowed to flow down the slope to runoff collection ditches. Land treatment processes are very efficient in removing biodegradable organics and suspended solids. Both the slow rate and the rapid infiltration processes remove phosphorus from applied wastewater very efficiently. Overland flow is less efficient because of the limited contact between the wastewater and the adsorption sites within the soil. Removal of pathogenic organisms is accomplished by filtration, adsorption, desiccation, radiation, predation, and exposure to other adverse conditions. Trace organics are removed by adsorption, biodegradation, photodecomposition, and volatilization. Trace elements removal involves adsorption, precipitation, ion exchange, and complexation. Research needs for land treatment of municipal wastewater include hydraulic aspects of soil systems and prediction of process performance, preapplication treatment and crop management. Sludge use issues continue to center on the public health concerns over cadmium, lead, toxic organics, and pathogens. (Baker-IVI)
W84-04889

MATRIX DIFFUSION EFFECTS ON CONTAMINANT MIGRATION FROM AN INJECTION WELL IN FRACTURED SANDSTONE,
Golder Associates, Mississauga (Ontario).
For primary bibliographic entry see Field 5B.
W84-05106

LAND TREATMENT OF CONTAMINATED SLUDGE WITH WASTEWATER IRRIGATION,
Muskegon County Wastewater Management System, MI.
Y. A. Demirjian, T. R. Westman, A. M. Joshi, D. J. Rop, and R. V. Buhl.
Journal of the Water Pollution Control Federation, Vol. 56, No. 4, p 370-377, April, 1984. 1 Fig, 11 Tab, 14 Ref.

Descriptors: *Sludge, *Land disposal, *Wastewater irrigation, Heavy metals, Zinc, Dichloroazobenzene, Chloroaniline, Crop yield, Plant growth, Organic compounds, Priority pollutants.

The fate of organic priority pollutants and additional man-made organics in sludge applied to wastewater-irrigated soils was investigated. Heavy metals were also monitored to determine their behavior under these conditions. The nutritive value of the sludge and the corresponding yield increases were not considered. Thirteen priority pollutants and seventeen additional organic compounds were present in the sludge which was applied at a rate of 40,333 Kg dry sludge/ha. Most of the organic compounds degraded, with the exception of 2,2'-dichloroazobenzene, which may have been mainly introduced through past irrigations. There is a possibility that microbial transformation of 2-chloroaniline could generate the 2,2'-dichloroazobenzene. Because of this it may be helpful to apply 2-chloroaniline to a virgin field. However, none of the intermediates in the microbial conversion of 2-chloroaniline and 2,2'-dichloroazobenzene were detected. Build up of metals in the soil was minimal. Zinc concentration increased slightly in the groundwater, but at least 50% of this could be related to either present or past irrigations. The corn grown on the sludge application area was chemically no different than that grown on the background area, only apparently healthier. (Baker-IVI)
W84-05144

5F. Water Treatment and Quality Alteration

WATER SUPPLY MANAGEMENT ENTERS A NEW ERA,
Raub (Jack G.), Mission Viejo, CA.
For primary bibliographic entry see Field 6A.
W84-04922

DIHALOACETONITRILES IN DRINKING WATER: ALGAE AND FULVIC ACID AS PRECURSORS,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 5B.
W84-04943

MANAGING WATER QUALITY BY MIXING WATER FROM DIFFERENT SOURCES,
Hawaii Univ., Honolulu. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3C.
W84-04955

CHEMICAL CHANGES OF ORGANIC COMPOUNDS IN CHLORINATED WATER; IX. FORMATION OF POLYCHLORINATED PHENOXYPHENOLS DURING THE REACTION OF PHENOL WITH HYPOCHLORITE IN DILUTE AQUEOUS SOLUTION,
Tokyo Univ. (Japan). Faculty of Pharmaceutical Sciences.
S. Onodera, K. Yamada, Y. Yamaji, and S. Ishikura.
Journal of Chromatography, Vol. 288, No. 1, p 91-100, April, 1984. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Chlorinated hydrocarbons, *Chlorination, *Phenols, *Hypochlorite, Water treatment, Chlorinated phenoxyphenols, Hydrogen ion concentration.

Aqueous phenol solutions were treated with hypochlorite at 20 degrees C under various experimental conditions. Changes in the composition of the chlorination products in water were determined by using gas chromatographic (GC) and GC-mass spectrometric analyses of diethyl ether extracts. Chlorination of phenol in dilute aqueous solution produced a series of highly chlorinated compounds, including chlorophenols, chlorobenzoquinones and chlorinated carboxylic acids. Tentative identifications were also made for other compounds with the following proposed molecular formulae: C12H8Cl2O2, C12H7Cl3O2, C12H6Cl4O2 and C12H5Cl5O2. On the basis of thin-layer chromatographic and GC behavior, these compounds are considered to be chlorinated

phenoxyphenols. Production of some of these compounds is dependent on the equivalents of chlorine per mole of compound and the reaction pH. These results show that treatment with chlorine of water contaminated with phenolic compounds leads to the production of chlorinated phenoxyphenols. (Author's abstract)
W84-05125

CONTROL OF ALGAE BY CHEMICAL TREATMENT IN A EUTROPHIC WATER SUPPLY RESERVOIR,
Essex Univ., Colchester (England).
C. R. Hayes, R. G. Clark, R. F. Stent, and C. J. Redshaw.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 2, p 149-162, April, 1984. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Eutrophication, *Reservoirs, *Algal control, Phosphates, Ferric sulfate, Sediments, Aeration, Chemical reactions, Algal growth, Water treatment.

There have been problems with eutrophication at the Foxcote reservoir, in England. Algal control in eutrophic public water supply reservoirs can be achieved by limiting the availability of the nutrient phosphate. The internal recycling of phosphate from reduced sediments is antagonistic to this objective. Control of soluble phosphate in the pumped river inflow to Foxcote reservoir at concentrations of up to 0.75 mg/l (P) has been achieved by ferric sulfate dosing at doses ranging from 3 to 5.4 mg/l (Fe). Short-term algal control can be achieved by ferric sulfate dressing. No residual iron or acidity problems were experienced. There is a need to optimize the method of application. Ferris floc deposited on the reservoir bottom can have a modifying influence on the chemistry of the surface sediment, but this does not yet appear to have been of significance at Foxcote except in the localized inflow area. The cost of ferric sulfate dosing is offset by reductions in the chemical requirements of water supply treatment to give an annual average net cost of 0.15 p/cu m. Control options for reducing internal recycling of phosphate include aeration and the removal of phosphate rich sediments; both could incur substantially greater cost than the current chemical treatment. These options may not be necessary, however, if internal recycling diminishes as a result of external loading control and reduced reservoir productivity. (Baker-IVI)
W84-05138

DISINFECTION OF DRINKING WATER BY ULTRAVIOLET LIGHT,
Severn-Trent Water Authority (England).
N. H. Groocock.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 2, p 163-172, April, 1984. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *Drinking water, *Disinfection, *Ultraviolet radiation, Water treatment, Bacteria, Turbidity, Reviews.

The state of the art of water disinfection through the use of ultraviolet light (UV) is reviewed. Topics discussed include the principles of the production of ultraviolet light, apparatus for the production of UV radiation (low and medium presure vapor lamps), factors affecting germicidal efficiency, monitoring germicidal efficiency, dosages for the inactivation of various organisms, requirements and operation of UV units, comparison of the advantages and disadvantages of UV treatment with chemical disinfection methods, and other uses of UV in related circumstances. UV radiation can be successfully used for water disinfection if the units are correctly sized and maintained and sufficient monitoring and control devices are incorporated. Alternatives should be sought, however, for highly polluted sources or those subject to poor UV transmission characteristics or variable turbidity, unless sufficient suitable, preliminary treatment can be incorporated. The process is particularly suitable for small water supplies to remote areas. (Baker-IVI)
W84-05139

TE MARUA WATER STORAGE PROJECT; WELLINGTON REGIONAL COUNCIL, NEW ZEALAND,
M. D. Palmer.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 2, p 173-176, April, 1984. 2 Fig.

Descriptors: *Storage reservoirs, *Water supply development, *Wellington, *New Zealand, Karori, Water storage, Water treatment.

The Te Marua storage project has been devised to provide significant additional storage of water for supplying the city of Wellington, New Zealand. Treatment is to be a conventional flocculator, bimedium rapid gravity filter with on site storage for backwash water and terminal storage for filtered water. The source is a clear slightly acid upland water which presently receives no treatment other than chlorination. The storage scheme with treatment capability will permit use of the source at all river stages which is not possible at present due to increased turbidity under storm run-off conditions. In operation, water will be passed into supply by gravity via a new purification plant on the same site, any surplus Kaitoke water overflowing into the water storage lakes. (Baker-IVI)
W84-05140

MUNICIPALITIES ACT TO SUPPLEMENT DWINDLING GROUNDWATER SUPPLIES,
G. Mahoney.
Public Works, Vol. 115, No. 5, p 84-85, May, 1984. 1 Fig.

Descriptors: *Water supply development, *Water conveyance, *Lake Michigan, *Chicago, Pipelines, Water treatment, Cost analysis.

A $335 million project to purchase and pipe treated water from Lake Michigan to the far western suburbs of Chicago will include constructing about 140 miles of mains, creating 90 million gallons of storage capacity in six locations, and two large pumping stations. Currently involved in the new project are 22 of the 34 municipalities in Du Page County. The water supply system will start with a connection to Chicago's Central Tunnel System at the Central Park Avenue pumping station on the near west side of the city. The lake water is less hard than the groundwater currently used and will not require softening. Costs of installing and maintaining wells will be eliminated and system maintenance expenses, such as corrosion prevention, will be reduced. (Baker-IVI)
W84-05150

EFFICIENT TELECONTROL IN WATER MANAGEMENT (KOSTENGUNSTIGE FERNWIRKTECHNIK IN DER WASSERWIRTSCHAFT),
Vollmar G.m.b.H., Stuttgart (Germany, F.R.).
H. Fahrner.
Wasserwirtschaft, Vol. 73, No. 3, p 76-86, March, 1983. 7 Fig, 3 Tab, 39 Ref.

Descriptors: *Telecontrol, *Water supply systems, Water management, Water control, Optimization, Operating costs, Capital costs.

Telecontrol in the water supply industry mostly works through private communication cable systems or leased circuits. Therefore the capital expenses and operating expenses are very high when traversing great distances. By the use of public networks of the post (telefon network and datexnet) a considerable savings in capital expenses and operating expenses could be experienced. (Murphy-IVI)
W84-05235

PUBLIC WATER SUPPLY AS SPHERE OF ECONOMIC ACTIVITY OF THE LOCAL AUTHORITIES (DIE OFFENTLICHE WASSERVERSORGUNG ALS WIRTSCHAFTLICHES BETATIGUNGSFELD DER GEMEINDEN),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
E. Muller.
Wasserwirtschaft, Vol. 73, No. 7/8, p 216-220, 1983. 6 Tab, 5 Ref.

Descriptors: *West Germany, *Bad-Wurttemberg, *Water supply, *Utilities, *Legal aspects, Economic aspects.

More than 96% of the population of the Federal Republic of Germany get their drinking water from public water supplies. These waterworks are operated by the local authorities. The legal obligations imposed upon the local authorities in Baden-Wurttemberg by virtue of their responsibility for this task as well as their legal status are reviewed. (Author's abstract)
W84-05245

NORWALK GASTROENTERITIS ASSOCIATED WITH A WATER SYSTEM IN A RURAL GEORGIA COMMUNITY,
Georgia Dept. of Human Resources, Atlanta. Office of Epidemiology.
For primary bibliographic entry see Field 5C.
W84-05284

5G. Water Quality Control

NEW TECHNOLOGY FOR NUTRIENT PRECIPITATION IN LAKES (EINE NEUE TECHNOLOGIE ZUR NAHRSTOFFALLUNG IN SEEN),
Wasserwirtschaftsdirektion Kueste, Neubrandenburg (German, D.R.).
E. Penz, and W. Dolgner.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 158-159, May, 1983. 2 Tab, 3 Ref.

Descriptors: *Aluminum sulfate, *Lake restoration, *Triensee, *East Germany, Flocculation, Phosphate removal, Ice cover, Nutrients, Phytoplankton, Hydrogen ion concentration.

Aluminum sulfate, Al2(SO4)3, was used to precipitate phosphate in the Triensee, a lake covering 1.5 ha and with an average depth of 2.5 m, near Murchin, German Democratic Republic. The small, shallow lake with unstable stratification contains one deep (5.5 m maximum) area surrounded by muddy shallows with phosphate-rich sediment. A larger dosage than is usual for lakes (4 tonnes Al2(SO4)3) was chosen to seal the phosphate in sediment and to overcome the lake's strong circulation with its sediment displacement. The agent was spread manually on the lake's ice cover on March 3, 1981; this represented a new technology. A favorable time for nutrient precipitation (pregrowing season spring total circulation) was artificially created, since the aluminum sulfate triggered a quick ice-melt. Contact between the granulated precipitating agent and the ice caused a highly concentrated solution, which precipitated dissolved orthophosphate evenly and effectively. No expensive flocculation aids were needed. The method can be used for all types of surface waters without high expenses. On March 9, 1981, the lake bottom was visible, and flocks were evenly distributed over the sediment. Microscopic examination showed that almost all phytoplankton were contained in the flocks. Orthophosphate could not be found, and 5-day BOD and COD were reduced by 5.0%. The lake has remained oligotrophic. However, a pH decrease to 4.8 occurred, and the lake was acid until August. (Gish-IVI)
W84-04797

PLUME DILUTION FOR DIFFUSERS WITH MULTIPORT RISERS,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Engineering Materials.
For primary bibliographic entry see Field 8B.
W84-04829

BAG EXPERIMENTS ON THE EFFECT OF PHOSPHORUS AND BASE ADDITIONS ON THE ALGAL BIOMASS AND SPECIES COMPOSITION OF AN ACID LAKE,
West Virginia Univ., Morgantown. Dept. of Biology.
G. R. Wilcox, and J. DeCosta.

Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 2, p 173-199, 1984. 15 Fig, 16 Tab, 33 Ref.

Descriptors: *Phytoplankton, *Phosphorus, *Acid lakes, *Bases, Acidity, Algal growth, Neutralization, Acidic water, Nutrients, Chlorophyll, Biomass, Lake restoration.

Bag experiments were performed during the summer of 1976 to determine the effect of nutrient and base addition on the algal biomass and species composition of an acidic lake. In one study, phosphorus (10 microg/l) was added alone and in combination with a base addition (NaOH) which raised the pH to 8.0-8.3. Other treatments included base addition alone and a control treatment in which neither nutrient nor base was added. In treatment 4, the experimental design was as above except that on day 12, base was added to the phosphorus treatment, phosphorus was added to the base treatment and acid was added to the phosphorus plus base treatment. Uncorrected chlorophyll a concentrations were greatest in the phosphorus plus base treatments which were greater than the concentrations in either the lake (sampled at surface and 1 meter depths), control, or base treatments. Base addition alone did not increase algal biomass compared to the lake and control treatments. Phosphorus plus base additions had notable growth lag times ranging from 6 to 10 days before greater chlorophyll concentrations were achieved. Base additions alone resulted in the reduction of the nannoplankton contribution to the total phytoplankton cell volume. Phosphorus and phosphorus plus base additions resulted in a nannoplankton dominance. The phosphorus plus base treatments became dominated by Chlorella sp., Scenedesmus quadricauda, and Ankistrodesmus falcatus. The dominant phytoplankton species present in the lake during these experiments were Peridinium inconspicuum, Dinobryon divergens, Botryococcus braunii, and Chlorella sp. (Baker-IVI)
W84-05013

SPECIATION: AN ESSENTIAL TOOL FOR THE ENVIRONMENTAL CONTROL OF INORGANIC CHEMICALS IN WATER,
Greenblatt, Greenblatt and Risenburger, Vineland, NJ.
F. J. Riesenburger.
Columbia Journal of Environmental Law, Vol. 9, No. 1, p 63-74, 1983. 1 Fig, 41 Ref.

Descriptors: *Speciation, *Pollutant identification, Wastewater treatment, Water analysis, Legislation, Monitoring, Water pollution control.

The speciation procedures described make it possible to qualitatively analyze compound forms and to quantify each different compound form. By accurately determining the water sites actually contaminated by the most hazardous inorganic or organic compound forms of an element, speciation could lead to a more effective allocation of funds for environmental control programs. Significant improvement of the environment by the use of speciation could also take place in other ways. Treatment methods implemented at existing water treatment plants are generally formulated on the basis of traditional bench scale analyses. Speciation could make possible the identification of certain compound forms which may not be responding optimally to such treatment methods. Introduction of a pretreatment or final polishing stage specifically addressed to the isolated problem compound form should increase significantly the efficiency of water treatment plants. Speciation could also provide a useful tool for the identification of the processors of certain chemicals found in surface waters, abandoned repositories and midnight dump sites. The EPA is currently reassessing the National Interim Primary Drinking Water Regulations, as the first step in the process of issuing new National Revised Primary Drinking Water Regulations. It is recommended that speciation be recognized by and incorporated into those regulations. (Baker-IVI)
W84-05046

RAPID DRAINAGE OF COAL SEAMS FOR PREVENTION OF ACID FORMATION,
R. B. Watson.
Water Science and Technology, Vol. 15, No. 2, p 103-114, 1983. 6 Fig, 2 Tab.

Descriptors: *Coal mining, *Acid mine drainage, Mine wastes, Boreholes, Drainage, Water pollution control, Adits.

The drainage of mineralized water from both operating and abandoned coal mines is a problem and clearly constitutes a serious source of stream pollution in the coal fields. The degree of acidity in mine drainage water can be reduced by removing the water from a mine as soon as practically possible. Coal extraction methods being used in South Africa are reviewed along with a study of the formation of acid mine water and drainage methods employed, which do provide some degree of success in the limitation of the acid content of the resultant mine drainage. Methods discussed include pumping (a common method of water removal which can be costly due to the corrosiveness of the waters being pumped), drainage adits (the method used being to drive a tunnel from below the coal seam outcrop to a point beneath the water accumulation), and borehole drainage systems. Success with drainage adits, properly planned and installed, has been promising for the rapid drainage of water from the workings of coal mines. The means by which drainage is effected from a mine will depend largely on the circumstances of the mine. Factors such as depth, mining method, quantity of water and whether or not acidity is likely to occur, have a bearing on the decision. (Baker-IVI)
W84-05090

ASSESSMENT OF THE EFFECTIVENESS OF BARRIERS FOR THE RETARDATION OF POLLUTANT MIGRATION,
Oklahoma Univ., Norman, Environmental and Ground Water Inst.
R. C. Knox.
Ground Water, Vol. 22, No. 3, p 279-284, May-June, 1984. 8 Fig, 3 Ref.

Descriptors: *Barriers, *Water pollution control, *Groundwater protection, Model studies, Path of pollutants, Mathematical models, Solute transport.

The analysis of the movement of contaminated ground water under or through an imperfect barrier is presented. The first phase of the analysis consists of the development of an analytical solution for the flow of ground water under a barrier and a simple numerical integration technique for developing concentration breakthrough curves. This simple solution algorithm was applied to the cases of variable recharge rates and lengths, variable depths of penetration of the barrier, and anisotropic soils. The second phase of the analysis involves applying a numerical solute transport model to analyze the performance of a barrier with and without the effects of hydrodynamic dispersion, and in the presence of a layered soil, and finally the performance of a fully penetrating but partially permeable barrier. The most efficient use of barrier technology appears to be placement of the barrier directly adjacent to the source of contaminated recharge. Unless a perfect connection can be made between the barrier and the underlying impermeable formation, the barrier does not provide complete containment. The barrier will provide an initial time lag before the appearance and increase in concentration of a contaminant under the barrier. When an aquifer with a waste source is highly conductive in the vertical direction, the effectiveness of a barrier is practically negligible. The numerical model and analysis employed was relatively simple, quick, and economical. (Baker-IVI)
W84-05103

MONITORING AND MATHEMATICAL MODELING OF CONTAMINATED GROUNDWATER PLUMES IN FLUVIAL ENVIRONMENTS,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
J. L. Osiensky, G. V. Winter, and R. E. Williams.
Ground Water, Vol. 22, No. 3, p 298-306, May-June, 1984. 9 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater pollution, *Monitoring, *Mathematical models, Monitoring wells, Sediments, Permeability, Channels, Streams, Fluvial environments, Plumes, Hydrogeology.

Groundwater monitoring to delineate a contaminant plume in fluvial hydrostratigraphic units often is uncertain. Hydrostratigraphic units deposited in fluvial environments consist typically of interbedded layers of sands, silts and clays, with sinuous buried stream channel deposits of sands or gravels. Failure on the part of investigators to understand the depositional environment that formed the hydrostratigraphic units may result in ineffective monitor well networks as the significance of buried stream channels may be overlooked. The results of mathematical modeling and the case history show that contaminants may migrate preferentially around monitor wells located immediately down gradient of the contaminant source. Awareness by investigating hydrogeologists as to the existence of buried stream channels is critical to optimal monitor well field design and correct interpretation of the resulting water quality data. (Baker-IVI)
W84-05105

GROUND-WATER QUALITY AT A CREOSOTE WASTE SITE,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
P. B. Bedient, A. C. Rodgers, T. C. Bouvette, M. B. Tomson, and T. H. Wang.
Ground Water, Vol. 22, No. 3, p 318-329, May-June, 1984. 6 Fig, 6 Tab, 22 Ref.

Descriptors: *Groundwater pollution, *Water quality control, *Monitoring, *Contore, *Texas, Wells, Creosote, Path of pollutants, Microorganisms, Organic compounds, Groundwater movement, Chlorides, Permeability, Hydraulic gradient.

An abandoned creosote facility in Contore, Texas has become a field site for a groundwater quality study. Groundwater contamination in the shallow aquifer beneath the site was characterized by sampling soils and water quality at 14 monitoring wells and 35 boreholes. An observed chloride and trace level organic plume of groundwater contamination exists up to 300 ft (91.5 m) from the pit locations. Background chloride concentrations of 15 mg/l are exceeded in all of the wells in the pit area. Naphthalene, 1-methyl naphthalene, 2-methyl naphthalene, dibenzofuran, and fluorene have the highest concentrations in specific wells. A groundwater flow net has been determined from water level measurements indicating that the groundwater is moving in a south and southwest direction with some convergence of flow near well number 1. Hydraulic conductivity values from field tests were used with a hydraulic gradient established from water table contours in the flow net to predict a groundwater seepage velocity of 4 ft/yr to about 10 ft/yr. Several wells exist in the general flow direction, but not directly down gradient from the waste pit locations. Microbial studies show that soil microbe populations do exist that are capable of degrading selected organics. The subsurface has not been penetrated beyond 44 ft in well 1 where 5 ft of clay was encountered. The shallow contaminated water is not being used as a drinking water supply. (Baker-IVI)
W84-05107

SYRINGE AND CARTRIDGE METHOD FOR DOWN-HOLE SAMPLING FOR TRACE ORGANICS IN GROUND WATER,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
J. F. Pankow, L. M. Isabelle, J. P. Hewetson, and J. A. Cherry.
Ground Water, Vol. 22, No. 3, p 330-339, May-June, 1984. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Groundwater pollution, *Sampling, *Monitoring, *Organic compounds, Burlington, Ontario, Boreholes, Piezometers, Measuring instruments.

A newly developed technique which allows the downhole sampling and subsequent analysis of groundwater for trace organic contaminants was tested during an investigation of contaminant mi-

gration at an inactive landfill site in Burlington, Ontario. The technique is based on the analytical method adsorption/thermal desorption and analysis by GC/MS/DS and has been developed for the determination of microg/l levels of organic contaminants in groundwater. The convenience of the technique for field use and the reproducibility of the results were encouraging. The technique enables samples to be obtained from any depth in piezometers or wells in a manner that minimizes losses due to volatilization and sorption on sampling equipment. Each cartridge is a dedicated sampler in that it is not used in more than one piezometer or well. Because the sample exists as a small, lightweight, porous cartridge regardless of the water volume that is sampled, the sample is in a form that is very convenient for packaging and shipping by mail or by air courier between field sites and distant analytical laboratories. (Baker-IVI)
W84-05108

NITRATE LEACHING AS INFLUENCED BY WATER APPLICATION LEVEL AND NITRIFICATION INHIBITORS,
Agricultural Research Service, Ames, IA.
D. R. Timmons.
Journal of Environmental Quality, Vol. 13, No. 2, p 305-309, April-June, 1984. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Nitrates, *Irrigation practices, *Nitrification inhibitors, Nonpoint pollution sources, Leaching, Water pollution sources, Nitrapyrin, Terrazole, Groundwater pollution, Fertilizers, Supplemental irrigation.

The effects of water application level and nitrification inhibitors on NO3-N leaching from a sandy loam soil were evaluated using soil columns and nonweighing field lysimeters. In soil columns (297 mm diam. by 1.2 m deep) fertilized with 224 kg N/ha, addition of the nitrification inhibitor nitrapyrin (2-chloro-6(trichloromethyl)pyridine) reduced NO3-N leaching losses by 51 and 30 kg/ha, respectively, for the 12.7- and 38.1-mm weekly water application levels. Both nitrapyrin and Terrazole (5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole) inhibitors were equally effective in reducing total NO3-N leaching losses from soil columns after 100 d for the 38.1-mm water application level. The change in flow-weighted NO3-N concentration due to use of nitrification inhibitors was about -0.4 to -1.0 mmol/L. Annual NO3-N leaching losses measured at the 1.2-m depth in field lysimeters cropped with corn (Zea mays L.) over a 3-yr period averaged about 12 kg/ha less (7%) for nitrapyrin-coated urea. The results were not consistent since nitrapyrin reduced NO3-N leaching during the growing season by 12 and 17% for 2 of the 3 yr and post season leaching by 35% for 1 yr. The change in flow-weighted NO3-N concentration (3-yr avg) due to nitrapyrin was -0.4, -1.5, and +0.9 mmol/L, respectively, for the growing season, post season, and pre-emergence periods. Nitrification inhibitors may help to minimize nonpoint-source pollution on sandy soil where supplemental irrigation is used by reducing and/or delaying NO3-N leaching particularly during the growing season when N is utilized by plants. (Author's abstract)
W84-05122

CONTROL OF ALGAE BY CHEMICAL TREATMENT IN A EUTROPHIC WATER SUPPLY RESERVOIR,
Essex Univ., Colchester (England).
For primary bibliographic entry see Field 5F.
W84-05138

HYDROTURBINE VENTING FOR DISCHARGE OXYGENATION,
Tennessee Valley Authority, Norris.
For primary bibliographic entry see Field 8C.
W84-05147

SIMULATION OF WATER POLLUTION GENERATION AND ABATEMENT ON SUBURBAN WATERSHEDS,
Washington Univ., Seattle. Coll. of Engineering.
For primary bibliographic entry see Field 5B.
W84-05160

RHINE - PRIORITY FOR DRINKING WATER (AM RHEIN - VORRANG FUR TRINKWASSER),
For primary bibliographic entry see Field 5D.
W84-05272

METHODOLOGY FOR THE CHARACTERIZATION OF WATER QUALITY: ANALYSIS OF TIME-DEPENDENT VARIABILITY,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
M. Lachance, and B. Bobee.
Journal of Hydrology, Vol. 59, No. 3-4, p 275-291, November, 1982. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Water quality, *Model studies, *Evaluation, Saint Lawrence River, Aquatic life, Water supply.

The general methodology for characterization of water quality is presented and applied, after elimination of spatial effects, to the analysis of time dependent variability of physicochemical parameters measured on 18 dates during the summer months of 1976 at 12 sampling stations on the Saint Lawrence River between Cornwall and Quebec City. A transferable methodology is presented for characterizing water quality in relation to various uses. The method is based on the use of multivariate statistical methods suitable to the analysis of large data tables. The method is applied to the analysis of time dependent variability of water quality in two cases, namely domestic water supply purposes and ability of the environment to sustain balanced aquatic life. The analyses lead to an overall interpretation of this variability and to a description of the relations between parameters, the relative importance of parameter variations during the period of study, the relations between parameter values intervals and groups of sampling dates, and the behavior of the set of parameters connected to a given use at different dates. The methodology may also be transferred to a river or a given watershed if multiple uses are considered at the same moment. (Baker-IVI)
W84-05342

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER SUPPLY MANAGEMENT ENTERS A NEW ERA,
Raub (Jack G.), Mission Viejo, CA.
D. W. Prasifka.
Civil Engineering, Vol. 54, No. 3, p 45-47, March, 1984. 1 Fig, 3 Ref.

Descriptors: *Water demand, *Water supply development, *Water management, Decision making, Planning, Water supply, Water use, California, Legislation, Risk management.

In a very broad sense, water supply planning has two components - demand fulfillment and hazard mitigation. The first involves providing sufficient water supplies to meet the ultimate water demands of a community. The second involves formulating a course of action to deal with short term and long term interruptions of the available water supply. The political climate in California over the past few years indicates that the era of redundancy planning may be drawing to a close. Rising energy costs and inflationary pressures have increased water rates, both wholesale and retail. The legislature has passed a bill to expand the statewide water importation system as part of one of the most expensive construction programs in the state's history. The impact of changing social attitudes on water management practices is most evident in the response of the Marin Municipal Water District located in the San Francisco Bay area to the 1976-77 drought. MMWD customers reduced their water use more than 60%. Their risk management strategy implies a willingness to live with a system that will periodically require varying levels of conservation to maintain a supply buffer during dry years. Innovative aproaches are the wave of the future. Such approaches must focus on both components of water supply planning - demands and hazards. In projecting ultimate water demands today's engineers must shy away from a blanket reliance on textbook or historical trends in water consumption. An innovative approach would use community characteristics as the most important consideration. The economic consequences of hazard mitigation must also be included in proper planning. Hazard mitigation in any form usually costs something. The threat of severe economic loss in the aftermath of a natural disaster is often used as justification for spending large sums of money on hazard mitigation for water lifelines. The social and economic impacts of natural disasters on the communities living at risk from these hazards should be evaluated. In this respect, hazard mitigation must be inherently political and technological. (Baker-IVI)
W84-04922

RELIABILITY ANALYSIS OF REVERSE OSMOSIS PLANT,
King Abdulaziz Univ., Jeddah (Saudi Arabia).
For primary bibliographic entry see Field 3A.
W84-04938

STRATEGIC PLANNING FOR A NATIONAL WATERWAYS SYSTEM,
Army Engineer Inst. for Water Resources, Fort Belvoir, VA.
A. L. Dietz.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 112, January, 1983. 5 Tab.

Descriptors: *Decision making, *Planning, *National Waterways Study, Risks, Federal jurisdiction, Risk analysis, Transportation, Shipping, Political aspects.

Risk and uncertainty dictated the study design developed for the Congressionally mandated National Waterways Study (NWS). The need for the strategic planning concept adopted for the NWS is explained in terms of the current federal, state and private planning environments. The assumptions used for the scenarios considered by the NWS are tabulated. These include total waterborne commodity flow forecasts, in millions of tons, the selected commodity growth by alternative scenarios from 1977-2003, major growth reaches under high coal export, and waterborne coal flow forecasts by reach, in million of tons. The uncertainties under which planning is carried out are reviewed. The results of analyses of future water transportation use and system capability under a mix of future conditions is summarized, and strategies posed to meet waterway capability needs under uncertain future conditions are described. The NWS results in recommendations to Congress in areas of institutional and policy change necessary to obtain a viable national waterway system that supports national goals. The framework plan, based on the lessons learned from strategies, offers a mix of politically achievable decision rules designed to reduce risk and uncertainty. (Baker-IVI)
W84-04952

MULTIOBJECTIVE APPROACHES TO RIVER BASIN PLANNING,
Control Data Corp., Tucson, AZ.
M. Gershon, and L. Duckstein.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 13-28, January, 1983. 2 Fig, 4 Tab, 29 Ref.

Descriptors: *Water resources development, *Decision making, Planning, Management, Water management, Santa Cruz River Basin, River basins, Game theory, Programming.

The impact of alternative water development strategies upon an urbanized area in the semi-arid Southwest is examined within a multiobjective context. ELECTRE, compromise programming,

cooperative game theory, and multiattribute utility theory were compared by applying each of them to the Santa Cruz River Basin as a case study. The cost effectiveness approach was used to formulate the problem within a multiobjective context, and 25 alternative systems were evaluated and ranked. All of these multi-objective techniques are applicable in river basin planning. The four multi-objective techniques yielded similar results. In the sensitivity analysis, several changes in parameter values were made. In general, all four methodologies are fairly robust with respect to these parameter changes. Since the results obtained by the different methods are similar, work should be done to determine other criteria upon which to base the model choice in future applications. Of the methods used in this study, only ELECTRE can be used to rank systems involving qualitative data with, however, an interval or ratio scale introduced to measure discordance on a cardinal scale. When applying multi-objective decision techniques, both the estimation and use of weights should be examined. It is not practical to attempt to choose one multiobjective decision making technique as the best, nor is it practical to select one as the best for a given problem or a given decision maker or analyst. A thorough understanding of the workings and assumptions of each technique is essential. (Baker-IVI)
W84-04953

ECONOMIC FEASIBILITY OF FLOOD CONTROL IMPROVEMENTS,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
R. A. Wurbs.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 29-47, January, 1983. 14 Ref.

Descriptors: *Flood control, *Economic feasibility, Planning, Water management, Management, Decision making, Cost-benefit analysis, Water policy, Public policy.

There is increasing difficulty in satisfying the economic feasibility criterion in the formulation of structural plans of improvement for flood control. The decreasing benefit-to-cost ratios should be an important consideration in formulating water policy. A reassessment of the role of the economic criterion in determining project justification is warranted. Benefit-cost analysis should play a strong role in project selection. Capabilities need to be developed into the planning and implementation process to allow the economic feasibility constraint to be relaxed whenever noneconomic considerations so dictate. In many respects, incorporation of noneconomic considerations in project justification can be achieved more effectively at the state and local level than at the federal level. The increasing difficulty in economically justifying plans of improvement should also encourage a reassessment of whether the discount rate formula appropriately represents the public interest under changing economic conditions. The economic feasibility issue contributes to the already critical need to develop procedures to expedite the water resources development process. In regard to project planning, the increasing difficulty in economically justifying flood control projects contributes to the need for more innovative plans incorporating a broader range of nonstructural and structural measure types and conditions, expanded evaluation and tradeoff analysis techniques, and improved capabilities for handling the uncertainties involved in an economic analysis. (Baker-IVI)
W84-04954

ENVIRONMENTAL ANALYSIS IN HYDROPOWER LICENSING: A MODEL FOR DECISION MAKING,
American Univ., Washington, DC. School of Government and Public Administration.
For primary bibliographic entry see Field 6G.
W84-05010

MANAGING WITH MICRO-COMPUTERS,
Southern Water Authority, Worthing (England). East Sussex Water and Drainage Div.
R. B. Armstrong.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 1, p 41-54, February, 1983. 8 Fig.

Descriptors: *Computers, *Water management, Management, Decision making, Microcomputers, Administration, Programming.

The effective use of low cost equipment for decision making, monitoring, and control for water management purposes is considered. The information is presented for technical managers who are unfamiliar with computers. Consideration is given to procurement of equipment, programs and packages, and examples of spreadsheet applications. The key words of modern micro-computing are flexibiliy and adaptability. A good general purpose package transforms the micro-computer into an easily usable tool capable of undertaking a wide range of tasks. At the same time the user does not have to invest a large amount of time to make effective use of the machine; neither does the user need to be able to write computer programs. The micro can also be used effectively by the manager's secretary, particularly for word processing. This is invaluable for small businesses or isolated site offices where one machine can serve many masters in different ways. It is flexible and it is able to save a considerable amount of time of both principal and support staff. This is particularly applicable to mundane administrative tasks and leaves more time for creative activity. (Baker-IVI)
W84-05051

PLANNING OF WATER RESOURCES DEVELOPMENT IN AN ARABIAN GULF STATE: QATAR, A CASE STUDY,
J. G. Pike.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 1, p 75-88, February, 1983. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Water resources development, *Systems analysis, *Qatar, Planning, Water management, Water reuse, Water demand, Groundwater management, Seawater, Desalination, Wastewater irrigation.

There are two fundamental aspects to the question of water development in Arabia: an historic lack of capital to tap underground water reserves; and an absolute scarcity of water in this area where rainfall is insufficient to recharge the aquifers enough to meet the heavy demand now being placed on them. Although the city-states of the Arabian Gulf have not yet developed highly diversified economies, where the injunctive use or optimal apportionment of different souces of water becomes an intricate and complex matter, the rapid pace of development and consequent over-exploitation of meager groundwater resources nevertheless poses a problem in development planning. This is particularly relevant in the situation where natural water resources are likely to be rapidly exhausted and where policies need to be formulated on the extent of future augmentation or substitution of supplies by high cost distilled seawater and the optimum re-use of effluent water. The application of systems analysis in developing a national water resources and agricultural development plan in Qatar has provided an example of how this may be approached. Economically there is no justification for the use of high cost distilled seawater water for agriculture but the systems analysis approach to the problem has shown that, to ensure a long term balanced strategy, and to compensate for over-exploitation of groundwater resources in the past, a modest amount of distilled sea water must be used if the use of treated sewage effluent is to be confined to the irrigation of a limited range of crops in currently uninhabited areas. (Baker-IV)
W84-05052

AQUIFER TESTING, MATHEMATICAL MODELING, AND REGULATORY RISK,
Idaho Univ., Moscow. Coll. of Mines and Earth Resources.
C.-P. Wang, and R. E. Williams.
Ground Water, Vol. 22, No. 3, p 285-296, May-June, 1984. 4 Fig, 5 Tab, 23 Ref.

Descriptors: *Aquifer testing, *Model studies, *Mathematical models, Planning, Water resources development, Water management, Decision making.

The dilemma of a knowledgeable groundwater quality regulator whose regulatory decision making process is confronted with the output of a mathematical model that is based on very limited field test data is described. A method is available to a regulator for assessing approximately a range of possible performances of a contaminated groundwater recovery well field using a range of input data derived from a very limited data base. A strong case is presented for presenting mathematical model outputs as ranges of values rather than as unique solutions. A range is determined by an examination of the level of sophistication of the field data base. Experience gained with 12 field sites is demonstrated. The more limited the field data base, the greater must be the range of defensible model outputs, and consequently, the greater the risk inherent in subsequent regulatory decisions. The regulator can assess the risks in the regulatory decision making process only if he is able to assess the extent to which the field data base for the model output reflects state of the art data collection and analysis technologies and methodologies. (Baker-IVI)
W84-05104

EMERGING CONCEPTS FOR THE CONDUCT OF STATE WATER RESOURCES PLANNING,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
L. Shabman.
Water Resources Bulletin, Vol. 20, No. 2, p 203-209, April, 1984. 23 Ref.

Descriptors: *Water resources development, *Planning, Decision making, Water supply development, State jurisdiction, Water policy.

The capacity of states to conduct water resources planning has increased in recent years in response to changes in federal water resources development programs. The states are pursuing an adaptive planning process focusing on specific policy issues and are attempting to maintain flexibility to adapt decisions to circumstances. Adaptive planning is based upon articulation of basic policy, interest group conflict management and provision of baseline information. Clearly each of the states will develop a planning process that best suits their individual needs. Indeed, the states are still experimenting with how they should approach their planning mission since the emphasis on the importance of state planning is a relatively recent occurrence in the history of U. S. water planning. While this experimentation continues, and while significant differences across states do occur, it is instructive to realize that the basic themes elaborated about the adaptive planning process do seem to be the dominant view of state planning at this time. (Baker-IVI)
W84-05159

OPTIMIZATION METHODS FOR WATER RESOURCES PLANNING PROBLEMS WITH MULTIPLE OBJECTIVES: I. SURVEY OF SOME SUITABLE METHODS (OPTIMIERUNGSVERFAHREN FUR WASSERWIRTSCHAFTLICHE PLANUNGSPROBLEME MIT MEHRFACHER ZIELSETZUNG: I. ZUSAMMENSTELLUNG GEEIGNETER VERFAHREN),
Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
W. Gunther, and H. Overland.
Wasserwirtschaft, Vol. 73, No. 7/8, p 221-225, 1983. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Planning, *Decision making, Water resources development, Multiobjective planning, Optimization.

The determination of the most appropriate project alternative in multiobjective water resources planning is very difficult, because the effects of the different alternatives relevant to each single objec-

ive are often incommensurable. This survey describes some optimization methods helping to solve such problems. Methods described include the following: Goal Programming, Lexicographical Method, Weighting Method, Constraint Method, Noninferior Set Estimation Method, STEM Method, Sequential Multiobjective Problem Solving Technique, Sequential Information Generator for Multiple Objective Problems, Trade-off Development Method, and Surrogate Worth Trade-off Method. (Moore-IVI)
W84-05246

OPTIMAL IRRIGATION PLANNING MODEL (EIN MODELL ZUR PLANUNG UND OPTIMIERUNG VON BEWASSERUNGSANLAGEN),
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. Al-Azawi, and G. Marotz.
Wasserwirtschaft, Vol. 73, No. 9, p 279-283, 1983. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Irrigation programs, *Planning, *Optimization, Decision making, Economic aspects, Crop yield, Soil type, Available water, Fertilizers.

The purposes of this study are: to formulate a model for distributing the available land and water to various competing crops, to decide the type and quantity of each crop that should be planted and to derive the cost benefit function useful for those responsible for planning irrigation projects. However, in this study only one objective will be considered, namely maximization of the net income. The unknown decision variable is the area planted with a feasible crop characterized by its soil type, available water, level of technology, labor, seeds, fertilizer and capital costs. (Author's abstract)
W84-05251

OPTIMIZATION METHODS FOR WATER RESOURCES PLANNING PROBLEMS WITH MULTIPLE OBJECTIVES: II. EXAMPLES OF PRACTICAL COMPUTATION AND PROBLEMS (OPTIMIERUNGSVERFAHREN FUR WASSERWIRTSCHASFTLICHE PLANUNGSPROBLEME MIT MEHRFACHER ZIELSETZUNG: II. ANWENDUNGSBEISPIELE UND AUFTRETENDE PROBLEME),
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
M. Becker, W. Gunther, and H. Overland.
Wasserwirtschaft, Vol. 73, No. 9, p 284-297, 1983. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Planning, *Water resources development, *Multiobjective planning, Fish, Wildfowl, Amphibians, Aesthetics, Hydroelectic power.

The use of three different multiobjective optimization methods is shown for a practical water resources planning problem including competing objectives, (water power production versus ecological and aesthetic requirements). Ecological objectives include the preservation of fish, amphibians, and waterfowl. The study is based on data taken during a total of 52 weeks from the middle of the years 1950 and 1979. (Moore-IVI)
W84-05252

EXPERIENCES IN MULTIOBJECTIVE PLANNING AND MANAGEMENT OF WATER RESOURCES SYSTEMS,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
U. Shamir.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 77-92, 1983. 8 Fig, 26 Ref.

Descriptors: *Water resources development, *Decision making, Water management, Planning, Multiobjective planning.

Multiobjective decision making is viewed as a philosophy and a process, rather than merely a set of procedures and algorithms. While methodologies are important, the framework within which they are applied and the communication between analysts and decision makers are the crucial determinants of the success of their application. A brief outline is offered of some methodologies which have been found useful in multiobjective planning and managment of water resources systems. Experience gained in several studies is presented. The examples described serve to demonstrate the types of situations were multiobjective decision making in water resources planning and management can be used. The most important features of the methodologies employed are those which create a framework for joint work of the analysts with the decision makers, in a learning process which allows progressive articulation of positions and preferences on the basis of previous analyses. (Baker-IVI)
W84-05299

OPERATING RULE DESIGN FOR RESERVOIR DAMS BUILT IN ORDER TO SUSTAIN LOW FLOWS. 1. THE YEARLY ALTERNATE PROCESS OF INFLOWS AND DEFICITS AS A TOOL (RECHERCHE D'UNE POLITIQUE DE GESTION DES STOCKS D'EAU DE BARRAGES-RESERVOIRS EN VUE DE SOUTENIR LES ETIAGES. 1. ELABORATION D'UN MODELE ALTERNE ANNUEL APPORTS-DEFICITS),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
C. Bocquillon, and J. M. Masson.
Journal of Hydrology, Vol. 60, No. 1-4, p 59-79, January, 1983. 13 Fig, 2 Tab, 6 Ref.

Descriptors: *Water shortage, *Reservoirs, Decision making, Statistical methods, France, Water supply development,.

Lack of water supply during periods of deficient flow affects the economic potential of the great river valleys which are the most developed areas in the country of France. The low flows and variability of water supply call for carry over procedures (reservoir capacity is sometimes greater than the mean available water). As it is not possible to predict future flow sequences, the carry over rule is used as a statistical decision making tool. The flow data are only one of several possible sources of information to be used. However, the analysis of flow data provides statistical measures to generate long series of synthetic inflows associated with summer deficits. A simplification is introduced by choosing only the values which are absolutely necessary for optimal management research: available water volumes and reserve volumes for a flow threshold. Yearly alternate periods of excess and deficiency of water are defined by the values above and below a threshold of flow discharge at a location gage named objective point, where the reservoir effects are to be estimated. Yearly periods are described by water volumes, either inflows into reservoirs, or deficits below various thresholds of summer flow discharges. Marginal and conditional probability distributions of these volumes and the physical laws which mark their bounds and relationships were estimated on the basis of 31 years of daily flow records. The synthetic simulated series of 1000 years was compared to records of historical levels. Extreme events such as sequences of dry years, have return periods of comparable magnitude. This synthetic series has a similar statistical character of short historical series and makes the analysis of operating rules possible. (Baker-IVI)
W84-05349

6B. Evaluation Process

IDENTIFYING ENVIRONMENTALLY ACCEPTABLE LEAST-COST POLLUTION CONTROL SYSTEMS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
M. F. Torpy, A. B. Bishop, and R. Narayanan.
Journal of Environmental Management, Vol. 15, No. 4, p 287-300, December, 1982. 11 Fig, 3 Tab, 11 Ref.

Descriptors: *Model studies, *Economic aspects, *Water pollution control, Waste disposal, Water reuse, Design criteria, Environmental effects, Linear programming, Water resources development.

A mathematical model based on mixed-integer programming was formulated to identify the least-cost treatment and recycle system among alternative pollution control units and environmental and production quality requirements. The model is presented as basis for production managers to evaluate treatment, recycle and discharge options under various conditions, such as changes in water and air quality standards, in plant standards and resource input costs. For a set of conditions, the model identifies the size of the required treatment units in the production treatment system, the flowrates of the influents and effluents, the treatment system's flow pattern, the quality of the water and air effluents, and quantity of residuals disposed of. The non-linear total costs, approximated by sets of linear cost segments, consist of operation and maintenance, water, energy, and capital cost inputs. The results of the applied model identify resource substitution with changes in resource input costs. The use of the model was demonstrated with the design of a 750-megawatt coal-fired steam electric plant. The model is useful to production facility planners in their efforts to minimize costs based on a consideration of changes in resource costs and other objectives. In addition, the method is useful for policy makers who must understand the costs related to changing environmental standards and even define the best available control treatment for the change. The most serious deficiency in the methodology is the inability to optimize with more than one residual parameter per physical phase (solid, liquid or gas). (Baker-IVI)
W84-04819

MEASURING AND PREDICTING WATER QUALITY IN RECREATION RELATED TERMS,
Resources for the Future, Inc., Washington, DC.
W. J. Vaughan, C. S. Russell, L. P. Gianessi, and L. A. Nielsen.
Journal of Environmental Management, Vol. 15, No. 4, p 363-380, December, 1982. 1 Fig, 6 Tab, 24 Ref. EPA grant No. R 806 906 010.

Descriptors: *Water quality, *Predicting, *Recreation, Estimating, Water pollution control, Model studies, Fishing, Policy.

The practical aspects are explored of quantitatively representing three of the five major linkages which are needed in order to estimate the monetary benefits accruing to recreational water users from nationwide implementation of water pollution control policies. These three are: the effects of the program on levels of pollutant discharge by source; the natural systems mechanisms for transportation, dilution, and transformation of pollutants which produce changes in ambient environmental conditions from changes in pollutant discharge levels; and the translation of the ambient changes from scientific measures such as dissolved oxygen into terms readily perceived and acted upon by recreators. A water quality simulation model with both source discharge and natural systems components is employed to predict the ambient effects of increasingly stringent water pollution control policies above a 1972 pre-policy baseline. The ambient effects are cast in recreation-specific terms - in this case, the quantity of fishable water available and its distribution across three broad categories of fish. The model's estimates of these quantities prior to policy implementation are compared to the estimates obtained by the authors from a survey of state fish and game agencies. Model forecasts of the availability of fishable water by species class in the US after the application of increasingly stringent national control policies are provided. This attempt suffers to some extent from several shortcomings: imperfect baseline data, modeling requirements pushing to and beyond the current limits of ability, and imperfect coverage of the totality of US water courses. However, this effort does demonstrate that considerable progress is possible. (Baker-IVI)
W84-04820

INTEGRATED SIZING OF WATER STORAGE AND CONVEYANCE,
Fleming (David E.) Co., Denver, CO.
D. E. Fleming, R. K. Hanson, and J. W. Labadie.
Journal of Water Resources Planning and Management, Vol. 109, No. 1, p 94-111, January, 1983. 10 Fig, 3 Tab, 7 Ref.

Descriptors: *Water supply development, *Management, Water storage, Reservoirs, Water conveyance, Conveyance structures, Colorado River Basin, River basins, Model studies, Dynamic programming, Optimum development plans, Optimization.

A methodology employing dynamic programming is presented for integrating the optimal design of water supply, treatment, and conveyance systems where the water demands for various uses vary during the year. Analysis begins with the water conveyance system so as to determine overall monthly water use coefficients for various levels of annual firm releases from the proposed reservoir that maximize net benefits. A firm yield analysis can then be conducted to determine the minimum capacity reservoir needed to supply various levels of firm yield according to the overall monthly water use coefficients computed previously by the dynamic programming algorithm. It is a relatively easy matter to then determine the optimum reservoir size that maximizes total net benefits. This specifies the optimum firm yield from the reservoir, which is in turn used to select the optimum design of each section of the water conveyance system, including pipeline sizings and water allocation to various uses. The results depend on the assumed future price or value of the water to various users. The optimal design of the water conveyance system can change significantly as the available supply changes. A unique feature of the work is that a generalized dynamic programming code called CSUDP was used. Instead of having to develop an entire dynamic programming code from the beginning for each new application CSUDP only required user supplied subroutines for the state transformation equation and objective function as well as input data. (Baker-IVI)
W84-04958

GAUGING THE ECONOMIC VIABILITY OF AGRICULTURAL LAND DRAINAGE SCHEMES,
Middlesex Polytechnic, London (England0. School of Geography and Planning.
E. C. Penning-Rowsell, and J. B. Chatterton.
Journal of the Institution of Water Engineers and Scientists, Vol. 38, No. 2, p 123-142, April, 1984. 4 Fig, 3 Tab, 48 Ref.

Descriptors: *Drainage, *Land development, *Cost-benefit analysis, *Agricultural land, Farming, Rainfall, Permeability, Model studies, Computer models, Economic aspects.

Agricultural land which suffers from poor drainage has only limited use. In practice there is a range of drainage problems. In addition to impeded drainage causing crop damage and reducing grazing potential, the structure of silty soils may suffer progressive deterioration and permanent damage with prolonged saturation. Gauging the economic viability of drainage schemes naturally concerns both costs and benefits, and the former can also be subject to uncertainties and imprecision. Decisions concerning drainage and drainage standards must also balance economic benefits against possible losses in the form of diminished nature conservation value or reduced landscape variety, although these cannot readily be quantified in economic terms. A computer model developed to systematize benefit assessment has four principle operations. Gross margin data appropriate to the benefit assessment in question is assembled from a large computer file of published data by a program called GMDAT. The gross margin data are related to each livestock enterprise and the land use of each field of block of land, which is assembled from farm interview data by program AGASS. The calculations by the program ENHANCEMENT can yield annual enhancement figures for each field and for each livestock type. These figures can be adjusted for each year of the scheme's life, based on anticipated percentage uptake data. Each year's enhancement is discounted to present values and then totalled to estimate the benefits in the form of a capital sum from which the present value of additions to fixed costs can be subtracted. (Baker-IVI)
W84-05137

PERCEIVED WATER QUALITY AND THE VALUE OF SEASONAL HOMES,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 5C.
W84-05153

WATER SUPPLY FORECASTING IN REAL-TIME,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
A. L. Huber.
Water Resources Bulletin, Vol. 20, No. 2, p 167-171, April, 1984. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Water supply, *Forecasting, Statistical models, Snowmelt, Snow water equivalent.

A strategy is developed for making seasonal water supply forecasts in real time. It links the traditional regression based forecasting techniques to real time data acquired by systems such as the Soil Conservation Service SNOTEL and the Bureau of Reclamation Hydromet networks. The concept is based on interpolating between the forecast values obtained by using real-time data in the forecast equations that bracket the real time. Different interpolation procedures were examined and the procedure for calculating confidence intervals about the forecast estimates is developed. The entire conceptual procedure is demonstrated using data from the Reynolds Creek, Idaho, experimental watershed. Advantages of the method include conceptual simplicity and established credibility, computational efficiency with minimum computer requirements, rapid implementation, and a bridge between historical and new real time data. (Baker-IVI)
W84-05154

INTERNATIONAL COOPERATION IN HYDROLOGY AND WATER RESOURCES DEVELOPMENT,
Rijkswaterstaat, The Hague (Netherlands).
A. Volker.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 49-56, 1983. 2 Fig.

Descriptors: *Hydrology, *Water resources development, International agreements, Decision making, Hydraulic design, Water management.

The history, nature and extent of the relationship between hydrology and the basic sciences and the international cooperation in that field are discussed. Hydraulic structures have been designed based upon experience obtained in a particular area and with a particular river and when such experience was missing a failure was bound to occur. The earliest dams were built without hydrological information and without knowledge of fundamental hydraulics and some still performed their function for many decades or even centuries with some of them still standing. Systematic international cooperation in the field of hydrology started in 1922 when a section for hydrology was established within the International Union of Geodesy and Geophysics. At the Moscow General Assembly of 1971 two important changes were made. The first was a change of the name of the association with scientific hydrology being replaced by hydrological sciences. The second change involved the establishment of a new Commission within the association, the Commission on Water Resouces Systems. Current matters of concern include the association of water management to the environmental impact of hydraulic works, the practical application of hydrology and water management under conditions prevailing in developing countries, the status of hydrology in developing countries, the prediction of hydrological side effects and their so-called environmental effects, and the application of history lessons to hydrology and water management. (Baker-IVI)
W84-05297

ECONOMIC ACTIVITY, WATER RESOURCES AND THE ENVIRONMENT; A CHALLENGE FOR HYDROLOGY,
United Nations Environment Programme, Nairobi (Kenya).
G. N. Golubev.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 57-75, 1983. 6 Fig, 4 Tab, 28 Ref.

Descriptors: *Water resources development, *Economic aspects, Hydrology, Environmental effects, Reviews.

Great pressure is exerted on hydrological, erosion/sedimentation and biogeochemical cycles by rapid economic development and population growth. The cycles are closely related with the hydrological cycle having the leading role. The roles of water withdrawals, reservoirs and transfers are discussed as compared with the natural components of the water balance. The impacts of irrigation and agriculture are considered in general. Closed lakes and their problems, and water management concerns stemming from the current water resources situation are investigated. The impacts of human activity on water and erosion/sedimentation are considered with particular emphasis on the consequences of agriculture. Impacts of economic activity on water and hydrochemistry are considered along with changes of chemical transport by rivers, and perturbations of the nitrogen and phosphorus cycles. The need for an active control of water resources and hydrologic regime on a large scale is considered. The control inevitably requires an interdisciplinary approach based on understanding the wide scope of hydrological processes. For hydrology there is no other way but to accommodate itself to this interdisciplinary setting. (Baker-IVI)
W84-05298

ASSESSING THE ENVIRONMENTAL BEHAVIOUR OF AQUATIC POLLUTANTS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. Stumm.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 93-102, 1983. 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Water quality control, *Pollutants, Decision making, Water management, Geochemical cycle, Xenobiotic substances, Environmental effects, Residence time, Biomagnification, Adsorption.

In view of the great number of existing chemicals and considering the large amount of environmental pollutants created every day by civilization there is a need to develop and apply general concepts (physical chemical substance specific data, unit processes) on the behavior, distribution and fate of pollutants in order to assess their environmental behavior and their potential effects on ecological systems and on human health. The geochemical cycle and its relationship to water quality are reviewed. The two most commonly used water quality criteria (the concentration of dissolved oxygen and the use of indicator organisms) are no longer sufficient as the character of pollution has changed over the last decades, especially in industrialized and densely populated regions. In interpreting the presence of indicator organisms, one is frequently at a loss to explain the cause and effect relationship of their presence. The response of aquatic ecosystems to xenobiotic substances, environmental analytical chemistry, and the chemical dynamics of pollutants are considered. (Baker-IVI)
W84-05300

OPTIMIZATION OF GROUNDWATER ABSTRACTION FROM A COASTAL AQUIFER,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4B.
W84-05304

QUANTITATIVE APPROACH TO DETERMINING LAND USE DENSITIES FROM WATER SUPPLY AND QUALITY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
P. J. Pizor, G. H. Nieswand, and R. M. Hordon.
Journal of Environmental Management, Vol. 18, No. 1, p 49-56, January, 1984. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Community development, *Land use, *Water supply development, Planning, Urban development, Water supply, Water demand.

As pressures mount on existing water supplies, a consideration of available water is becomming of increasing concern to those planners responsible for setting lot size recommendations. Until recently no specific linkage had been made between the volume and quality of water and the consequent lot size. Current planning capacity is a measure of the ability of a region to accommodate growth and development within limits defined by existing infrastructure and natural resource capabilities. A model is developed for determining CPC for areas serviced by infrastructure, or by on-site septic systems and wells. Infrastructure capacity is a function of water supply and sewerage treatment plant capacity, existing pipe sizes, and current demand. CPC calculations for on-site water supply potential are a function of the productivity of the underying aquifer. On-site water quality impact is estimated by the dilution capability of groundwater. The application of the CPC model for water supply and water quality parameters and subsequent lot size recommendations for a growing municipality are presented. A quantitative approach is offered for areas served by on-site wells and septic systems, for areas served by on-site wells, and for non-sewered areas. (Baker-IVI)
W84-05305

ECONOMIC RESULTS OF SIMULATED CHANGES IN PAKISTAN'S IRRIGATION SYSTEM,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 3F.
W84-05335

OPERATING RULE DESIGN FOR RESERVOIR DAMS BUILT IN ORDER TO SUSTAIN LOW FLOWS. 1. THE YEARLY ALTERNATE PROCESS OF INFLOWS AND DEFICITS AS A TOOL (RECHERCHE D'UNE POLITIQUE DE GESTION DES STOCKS D'EAU DE BARRAGES-RESERVOIRS EN VUE DE SOUTENIR LES ETIAGES. 1. ELABORATION D'UN MODELE ALTERNE ANNUEL APPORTS-DEFICITS),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 6A.
W84-05349

OPERATING RULE DESIGN FOR RESERVOIR DAMS BUILT IN ORDER TO SUSTAIN LOW FLOWS. 2. OPERATING RULE FORMULATION (RECHERCHE D'UNE POLITIQUE DE GESTION DES STOCKS D'EAU DE BARRAGES-RESERVOIRS EN VUE DE SOUTENIR LES ETIAGES. 2. UTILISATION D'UN MODELE ALTERNE ANNUEL APPORTS-DEFICITS POUR LA RECHERCHE DES CONDITIONS DE GESTION),
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
C. Bocquilon, and J. M. Masson.
Journal of Hydrology, Vol. 60, No. 1-4, p 81-104, January, 1983. 10 Fig, 1 Tab, 3 Ref.

Descriptors: *Reservoirs, *Design criteria, Decision making, Flow, Water supply development, Water management, River Loire, France.

The construction of five reservoirs was planned for the upper catchment of the River Loire, France, to sustain the low flows in the Loire valley. Daily draft decisions must be made at every stage of the project. A hydrological criteria concerning the low flows at a station in the valley is used to judge the results. It is possible to determine the optimal reservoirs and annual deficits, when the future conditions are presumed to be known. The statistical analysis of the results aids in the formulation of the objectives for the long term assuring the carry over storage for a predetermined risk of failure. This long term objective will not hold good if the low flow is severe. Thus some deterministic and statistical hypotheses have been used to formulate an objective for the mean term of flow which is calculated each day and adjusted to the hydrological conditions of the year. Water is discharged each day to meet this target flow, while maintaining all the constraints of the flows downstream to the reservoirs. It takes into account the time needed for transfer of water and permits a good prediction of either the flow propagation in the upper watershed or the evolution of the inflows from downstream catchments. A modular model is used to calculate the daily flow. The results obtained from simulation were satisfactory. (Baker-IVI)
W84-05350

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ESTIMATING THE VALUE OF WATER AMONG REGIONAL ECONOMIC SECTORS USING THE 1972 NATIONAL INTERINDUSTRY FORMAT,
Max C. Fleischmann Coll. of Agriculture, Reno, NV. Div. of Agricultural Economics.
T. R. Harris, and M. L. Rea.
Water Resources Bulletin, Vol. 20, No. 2, p 193-201, April, 1984. 2 Tab, 33 Ref.

Descriptors: *Water allocation, *Value, *Economic growth, Economic development, Linear programming, Model studies, Estimation, Social aspects.

With economic expansion, esecially in the western U.S., the adequacy of future water supplies to sustain economic growth is questioned. Not only will economic expansion increase demands upon current water resources but the question of western rivers maintaining adequate instream flow compounds this problem. An interindustry-linear programming model based on the 1972 national model format was developed which could be used for water resources planning. The interindustry-linear programming model allocates water among competing economic sectors, which maximizes regional value added while meeting the constraints of the regional economy. Since current water allocations are done by property right or other institutional arrangements and not by a market mechanism, the potential for misallocation of water exists. Using the interindustry-linear programming model, marginal value of water for different users is derived and allocation of water resources which maximizes social welfare is determined. (Moore-IVI)
W84-05158

VESSEL LICENSING FEE AS AN ALTERNATIVE PROPOSAL FOR A DEEP DRAFT WATERWAY USER CHARGE,
Oregon State Univ., Corvallis. Dept. of Agricultural and Resource Economics.
M. V. Martin.
Water Resources Bulletin, Vol. 20, No. 2, p 219-221, April, 1984. 1 Tab.

Descriptors: *User charges, *Waterways, Water cost, Ports, Licenses, Shipping, Benefits, Costs, Maintenance, Operation.

Congress is considering the imposition of a user fee on deep draft waterways and ports. Two major bills emerged in the 98th Congress. One proposes a tax on import-export value while the other proposes a tax on import-export tonnage. Another user fee alternative is suggested, a vessel licensing system. The advantages of such a fee system are outlined under a set of assumed objectives and the range of possible license charge levels is discussed under a cost recovery target of $250 million. This proposal for financing some portion of Federal deep draft waterway improvement, operation and maintenance expense, rests on the notion that U.S. ports and trade would be only minimally affected by a fixed cost increase for ocean vessels. A license fee would be relatively easy to collect. Moreover, enforcing compliance would require little new bureaucracy. (Baker-IVI)
W84-05161

ANALYSIS OF RISING IRRIGATION COSTS IN THE GREAT PLAINS,
G. R. Sloggett, and H. P. Mapp.
Water Resources Bulletin, Vol. 20, No. 2, p 229-233, April, 1984. 1 Fig, 4 Tab, 8 Ref.

Descriptors: *Water costs, *Great Plains, *Irrigation water, Groundwater recession, Energy costs, Inflation, Groundwater irrigation.

Irrigation costs are rising rapidly on the 32 million acres irrigated with ground water. Ground water levels are declining under about 15 million of those acres adding to increased costs. However, from 1975 to 1982, 75 to 80% of increased ground water irrigation costs were due to higher nominal energy prices and interest rates. In real dollars, adjusted for inflation, these costs have risen faster than other irrigation costs and the real rise in commodity prices has been very small. A continuation of rapidly rising costs and slowly rising prices will shorten the economic life of those aquifers experiencing declining water levels. That same condition of prices and costs place all ground water irrigators in a disadvantaged position compared to non-irrigators and could cause a decline in ground water irrigation. (Author's abstract)
W84-05163

CAPITAL COSTS OF RURAL WATER SYSTEMS: AN EMPIRICAL APPROACH,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
G. Ramamurthy, and D. L. Chicoine.
Water Resources Bulletin, Vol. 20, No. 2, p 255-260, April, 1984. 3 Tab, 13 Ref.

Descriptors: *Rural areas, *Water distribution, *Water treatment facilities, *Capital costs, Cost analysis, Construction costs, Econometrics, Water conveyance, Storage tanks, Pipelines.

Because of design and material differences, capital cost estimates from urban systems are not uniformly applicable to rural water services. This study presents an econometric analysis of capital costs, using Illinois rural water system construction contract bids. Capital costs are defined as any expenditure involved in completing construction of systems including material, labor, interest and professional services. Items included are ground and elevated steel storage tanks, the major conponents of the pipeline system, the distribution network and the treatment plant. Cost data analyzed account for 90% of the capital costs of water treatment and distribution systems providing farm and nonfarm users in the countryside domestic water service in Illinois. The information presented on capital costs is not intended to replace the detailed cost estimates required for bidding contracts or for costing out a specific rural water system. The type of information can be useful in initial feasibility analysis, general planning programs and the like. (Moore-IVI)
W84-05167

MODEL FOR CONSTRAINED OPTIMUM WATER PRICING AND CAPACITY EXPANSION,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
G. C. Dandy, E. A. McBean, and B. G. Hutchinson.
Water Resources Research, Vol. 20, No. 5, p 511-520, May 1984. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Pricing, Economic aspects, Model studies, Water management, Water supply, Optimum development plans.

A general model is presented for identifying the water price horizon so as to maximize the present value of net benefits. Previous studies of optimum water pricing and capacity expansion have ignored the political and administrative factors which limit the range of feasible decisions. Constraints on the range of water price, the rate of price change, and financial cost recovery are included in this model. The model is solved using discrete dynamic programming. The general model was applied to a hypothetical case study of an urban water supply system in order to evaluate the effectiveness of constrained and unconstrained optimum water pricing and capacity expansion. When compared to the current practice of average cost pricing, optimum pricing and capacity expansion are likely to result in some increases in net economic benefits, although the percentage increase in unlikely to be large. The imposition of administrative constraints on price changes and cost recovery tend to produce more realistic pricing policies but with some loss in net economic benefits resulting in only a slight improvement over average cost pricing. (Baker-IVI)
W84-05325

ECONOMICAL WAYS OF DEALING WITH WATER SUPPLIES IN THE USSR (ZUM WIRTSCHAFTLICHEN UMGANG MIT WASSERVORRATEN IN DER UDSSR),
Ministerstvo Melioratsii i Vodnogo Khozyaystva SSSR, Moscow.
I. Borodawtschenko, and I. Losanowskaja.
Wasserwirtschaft-Wassertechnik, Vol. 33, No. 5, p 172, May, 1983.

Descriptors: *Water supply, *Water supply development, Water conservation, Water use, Water use efficiency, Irrigation systems.

A 25% reduction in polluted wastewater entering surface waters and a 2% decrease in water-transport-related losses have been achieved in the USSR. During the last 10 yr, water-conservation measures have been instituted in 135 towns and in 1,045 companies in the most important river and sea basins. The Water Surveillance Agencies of the Ministry for Land Improvement and Water Management play an important role in rational and economic water use, not least in granting permits for special water use, which is only done when the applicant is willing to raise the level of multiple water use, institute water-conserving technological processes, and achieve a higher standard of wastewater treatment. The Water Management Ministry is currently working on a series of documents setting standards in this area. Businesses are now required to submit drafts of their annual and five-year plans for nature conservation to the local soviet before sending them to the authorities. In addition, 50% of water that must be paid for is now part of the local budget. The role of the soviet has thereby been increased. Significant water savings can be realized through the implementation of progressive water-use norms in agricultural irrigation; such norms are yet to be developed. The agricultural community can help reduce freshwater demand by using more irrigation-runoff water, wastewater from agricultural production, and municipal wastewater for irrigation purposes. Wastewater utilization also ensures a stable animal-feed supply and prevents pollution of water resources. Plans for 1983 include first-time irrigation of 677,000 ha and drainage of 715,000 ha. Renovation of equipment on 940,000 ha will also occur. (Gish-IVI)
W85-04801

6D. Water Demand

PROJECTIONS OF OUTDOOR RECREATION PARTICIPATION FOR WYOMING: 1995,
Wyoming Water Research Center, Laramie.
J. Carlson, and C. Phillips.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84 171115, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, May, 1980. 161 p, 15 Tab, 2 Append. Project No. OWRT A-025-WYO(1), Contract/Grant No. 14-34-0001-9054.

Descriptors: *Recreation, Water allocation, Water management, Planning, Boating, Fishing, Swimming, Camping, *Wyoming, *Recreation demand, *Recreation facilities, *Surveys, Projections.

Through use of Survey questionnaires, projected estimates are provided for: 1) current activities by Wyoming residents and project participation to the year 1995; and 2) The use of Wyoming's major streams and standing waters for selected water-based recreation activities. A cross-section survey of Wyoming households was used to collect the basic recreation data needed of: who participates, how often, and where. The population from which the main sample was drawn consisted of all households listed in Wyoming telephone directories. Three special population groups were surveyed to obtain information on their recreation participation: handicapped people, Indians, and new residents of the state. A second questionnaire was used to collect information from participants regarding the area where they participated for use in allocating the statewide estimates and projections to the seven planning regions in the state.
W84-04885

SHARE OF HYDRO-ELECTRIC POWER IN THE WORLD ENERGY BALANCE (PLACE DE L'HYDROELECTRICITE DANS LE BILAN ENERGETIQUE MONDIAL),
Electricite de France, Paris. Direction de l'Equipement.
J. Cotillon.
La Houille Blanche, Vol. 5/6, p 381-392, 1982. 3 Fig, 10 Tab, 12 Ref.

Descriptors: *Hydroelectric power, *Electric power production, Resources development, Pumped storage, Peaking capacity, Water resources development, Powerplants, Hydroelectric plants.

Total developable hydropower is estimated at 10,000 - 12,000 TWh, representing 27% to 33% of the total theoretical potential. Hydropower is more evenly distributed throughout the world than coal, oil, gas, or uranium reserves, although within large regions there may be considerable imbalance, with most of the potential being concentrated at a few sites. In 1978, developed potential represented only 17% of the developable potential (98,000 TWh) and 21.7% of total electricity production. Two-thirds of the developed potential was confined to the 24 OECD countries, which have harnessed 50% of their potential on the average; France had reached 90% by the end of 1981. By the year 2000, 35% might be developed, with the OECD countries accounting for 15%, the USSR, India, Mexico, Brazil and Yugoslavia accounting for 12%, and the rest of the world, 8%. Pumped storage is expanding rapidly in Japan, USA, and western Europe. It is just as attractive to engineers and the construction industry as conventional hydro, but it does not produce energy; it merely stores it for future use. Conventional hydro schemes are also growing in size, being increasingly sited on large rivers in the plains. Where alternative capacity exists on the grid, hydropower is being used for peaking duty. The share of hydropower in total electricity will have dropped from 40% in 1925 to 13% by the year 2000. Its share in total energy, which rose form 1.7% in 1925 to 5.3% in 1974, is expected to reach 6-7% by the end of the century. (Moore-IVI)
W84-05017

CONSUMPTIVE WATER USE OF IRRIGATED PECANS,
Texas A and M Research and Extension Center, El Paso.
For primary bibliographic entry see Field 3F.
W84-05071

ESTIMATING THE VALUE OF WATER AMONG REGIONAL ECONOMIC SECTORS USING THE 1972 NATIONAL INTERINDUSTRY FORMAT,
Max C. Fleischmann Coll. of Agriculture, Reno, NV. Div. of Agricultural Economics.
For primary bibliographic entry see Field 6C.
W84-05158

PRIVATE AND INDUSTRIAL WATER DEMAND IN WEST GERMANY (DER PRIVATE UND INDUSTRIELLE WASSERBEDARF IN DER BUNDESREPUBLIK DEUTSCHLAND),
Umweltbundesamt, Berlin (Germany, F.R.).
H. Langer.
Wasserwirtschaft, Vol. 73, No. 7/8, p 210-215, July-August, 1983. 6 Fig, 6 Ref.

Descriptors: *Water demand, *West Germany, *Domestic water, Industrial water, Computer models, Prediction, Energy, Water use, Consumptive use.

The present water demand of specific consumer sectors (domestic, industry, and energy production) in the Federal Republic of Germany are compared with possible alternative developments in these sectors up to the year 2010. The predictions are based on a computer-aided forecasting model. The model is designed to predict water use, water withdrawal and water consumption. The largest increase in water-withdrawal would be in energy production (68%). The model predicts an increase of 23% for industry and 9% for the domestic sector. Water use would increase 37% for energy production, 7% for industry, and 16% for the domestic sector. Water consumption would increase 58% for energy production, 39% for industry, and 3% for the domestic sector. (Moore-IVI)
W84-05244

QUANTITATIVE APPROACH TO DETERMINING LAND USE DENSITIES FROM WATER SUPPLY AND QUALITY,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 6B.
W84-05305

6E. Water Law and Institutions

INCENTIVES AND DISINCENTIVES FOR WATER CONSERVATION IN THE CALIFORNIA STATE WATER POLICYMAKING PROCESS,
California Univ., Los Angeles. Dept. of Political Science.
For primary bibliographic entry see Field 3D.
W84-04882

CHANGING ALLIANCES IN CALIFORNIA WATER ISSUES,
California Univ., Davis. Dept. of Applied Behavioral Sciences.
D. Gwynn, and O. E. Thompson.
California Agriculture, Vol. 38, No. 3-4, p 20-22, March-April, 1984. 2 Tab. Univ. of CA Agricultural Experiment Station grant 3559.

Descriptors: *Legislation, *Water resources development, *Political aspects, *California, Water conservation, Agriculture, Water use, Decision making, Peripheral Canal Referendum, Water Resources Initiative Statute.

The Peripheral Canal referendum, which would have allowed major water development projects to proceed, and the Water Resources Initiative Statute, which would have introduced many restricions on water use, including groundwater management, were placed before the voters in California in 1982. Both proposals were soundly defeated. The latter of the two would have added new sections to the State Water Code. It would have revised laws by requiring a water conservation program to be in place in overdrafted natural watershed basins before new or increased basin transfers of more than 20,000 acre-feet per year could be approved. These recent political battles suggest that no single monolithic group controls the development of water policy in the state. While some powerful interests such as oil and utilities remained united on the same side in each election, others became substantially less or more involved depending on what was at stake for them. The coalition most likely to win in a political conflict over water will likely be the one that is

able and willing to spend to most money on the campaign, regardless of the number of donors involved. (Baker-IVI)
W84-04887

DISTRICT MANAGEMENT FOR CALIFORNIA'S GROUNDWATER,
California Univ., Berkeley. School of Law.
D. A. de Lambert.
Ecology Law Quarterly, Vol. 11, No. 3, p 373-400, 1984. 183 Ref.

Descriptors: *Groundwater management, *Legislation, *California, Legal aspects, Water management, Water resources development, Water demand, Water use, Water allocation.

California's current groundwater management law is woefully inadequate. Increased pumping of overdrafted basins, with its concomitant side effects, is an unsatisfactory means of allocating a scarce and valuable resource. Only a comprehensive statewide management program can effectively protect groundwater resources. Pumpers currently depend on the courts to provide basin by basin solutions. Unfortunately, courts are not well equipped to allocate groundwater. Court resources are already overtaxed, and continuing jurisdiction merely adds to their burdens. Furthermore, overdraft requires immediate solutions to prevent environmental and economic havoc, while groundwater adjudications typically drag on for years. Groundwater allocations ultimately require policy decisions better resolved by the legislature than the courts. Politics is the process of deciding who gets how much, when, and why. Without a doubt, the allocation of groundwater fits within this definition. Where too many are demanding too much of a scarce resource, political choices must be made. (Baker-IVI)
W84-05045

LEGISLATING COST-BENEFIT ANALYSIS: THE FEDERAL WATER POLLUTION CONTROL ACT EXPERIENCE,
Jenner and Block, Chicago, IL.
J. K. Baum.
Columbia Journal of Environmental Law, Vol. 9, No. 1, p 75-111, 1983. 116 Ref.

Descriptors: *Water pollution control, *Legislation, *Cost-benefit analysis, Decision making, Water management, Federal jurisdiction, Political aspects.

Increased use of cost-benefit analysis is a key element of current efforts to reform the federal regulatory process, particularly in the field of environmental regulation. The cost benefit analysis requirements for effluent limitations and new source performance standards under the Federal Water Pollution Control Act (FWPCA) amendments of 1972 and 1977 offer particularly useful guidance. Despite gradations of analysis, the cost tests under the various FWPCA provisions have blurred, and this deviation from the statutory language has been largely countenanced by the reviewing courts. This blurring has resulted in ad hoc evaluations by EPA administrators, who treat all steps of the regulatory schedule the same, thus thwarting the goals of predictability and intellectual coherence in the law. The legislative history of best available technology, best available demonstrated control technology and best conventional pollutant control technology is reviewed. Both the executive branch and the judicial branch are cited for the failure of the FWPCA's cost consideration scheme. The EPA has twisted ambiguous statutory language and defined unambiguous language in the service not of environmental protection but of institutional discretion. The fundamental failure however, has been a legislative one. The FWPCA demonstrates the heavy price the public pays when legislators resolve the differences among themselves by enacting deliberately ambiguous legislation. While cost benefit analysis is unquestionably a useful tool in decision making, it is no substitute for the clear expression of congressional values, preferably on the face of the statute. (Baker-IVI)
W84-05047

COPING WITH UNCERTAINTY IN ENVIRONMENTAL DECISIONS,
Thermo Electron Engineering Corp., Waltham, MA.
A. M. Duda, M. T. El-Ashry, and A. Bruch.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 95-98, March-April, 1984. 2 Fig, 8 Ref.

Descriptors: *Planning, *Water conservation, Decision making, Environmental effects, Legislation, Policy making, Public rights, Drinking water, Acid rain.

The three key commonsense principles followed in TVA's decision on the soil erosion and stream blockage problem were also important factors in developing their position on acid precipitation. Despite uncertainties associated with acid precipitation, especially cause-and-effect relationships, facts were considered. A wealth of circumstantial evidence was revealed about the risks to sensitive ecosystems posed by acid precipitation. In order to minimize these risks, TVA decided to adopt the position that emissions should not be increased and, in fact, should be decreased until more information was available. A feedback system is established for fine tuning the program as more information is made known. An initial modest emissions cap could have served as the first step in an approach to controlling acid precipitation precursors in 1982. Decision makers cannot afford to wait until definitive answers to all uncertainties are reached. (Baker-IVI)
W84-05054

REGULATION OF TOXIC POLLUTANTS UNDER THE CLEAN WATER ACT: EPA'S TEN YEAR RULEMAKING NEARS COMPLETION,
Wyche, Burgess, Freeman and Parham, Greenville, SC.
B. W. Wyche.
Natural Resources Lawyer, Vol. 15, No. 3, p 511-536, 1983. 4 Tab, 128 Ref.

Descriptors: *Water pollution control, *Legislation, *Clean Water Act Legislation, Water quality, Hazardous materials, Regulations, Pollutants, Political aspects.

EPA's ten year struggle to establish regulatory controls on toxic pollutants under the federal Clean Water Act is reviewed. The history of the litigation is cited, the federal district court's three substantive opinions issued in the case during 1982 are analyzed, and the possibility of legislative intervention is considered. Although enacted in 1948, the Clean Water Act did not become an effective piece of environmental legislation until 1972. Even then Congress hoped for a swiftly established and effective toxic pollutant control program. This hope proved illusory as large gaps appeared in scientific information on toxic pollutants and the EPA failed to meet the ninety-day deadline for publishing its list of toxic pollutants. At the time the 1972 Amendments were enacted, Congress created the National Commission on Water Quality to assess the effectiveness of the new statutory scheme in improving water quality and to suggest any changes in the act that might be necessary. This resulted in the Clean Water Act of 1977. A tabular summary of the status of EPA's toxic pollutant control regulations as of April 1, 1983 is offered. The impact of EPA's delay in establishing limitations on each pollutant of concern in a particular discharger's waste stream and possibility of legislative response is considered. A deadline suit has been started which involves issuance of the hazardous wastes landfill regulations. The basic problem is that the deadline suit interjects a court in the middle of what is essentially a political dispute between the legislative and executive branches of government. Moreover, any order issued in such a case is unenforceable as a court cannot write the regulations in question or appropriate additional funds for the agency to do so. (Baker-IVI)
W84-05077

GEOGRAPHICAL ANALYSIS OF VOTING PATTERNS FOR WATER RELATED CONSTITUTIONAL AMENDMENTS IN TEXAS, 1957-1981,
North Texas State Univ., Denton. Dept. of Geography.
F. A. Schoolmaster, III.
Water Resources Bulletin, Vol. 20, No. 2, p 151-162, April, 1984. 9 Fig, 1 Tab, 44 Ref.

Descriptors: *Legislation, *Texas, *Water resources development, *Water quality, Voting, Reservoirs, Funding, Water management, Public opinion, Public participation, Attitudes.

County level electoral data were used to analyze the voting patterns of eight water related constitutional amendment elections. Both water quality enhancement amendments (1971, 1976), and three of six water development amendments (1957, 1962, 1966) have been ratified, thus establishing a statewide policy of reservoir development, a funding mechanism to implement such a policy, and the creation of a water management agency. Beginning with the 1969 election, a West Texas-East Texas regionalized voting pattern has emerged, resulting in the defeat of three amendments (1969, 1976, 1981) intended to provide additional funding for water development. This regionalization reflects different climatic, physiographic, economic, and locational factors, and represents a potential obstacle to coordinated water management in Texas. (Author's abstract)
W84-05152

PUBLIC WATER SUPPLY AS SPHERE OF ECONOMIC ACTIVITY OF THE LOCAL AUTHORITIES (DIE OFFENTLICHE WASSERVERSORGUNG ALS WIRTSCHAFTLICHES BETATIGUNGSFELD DER GEMEINDEN),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 5F.
W84-05245

UTILIZATION OF THE RESULTS OF WASTEWATER TAX CONTROL TESTING FOR OTHER PURPOSES (VERWENDUNG VON ERGEBNISSEN DER ABWASSERABGABEN-UBERPRUFUNGEN ZU ANDEREN ZWECKEN),
For primary bibliographic entry see Field 6F.
W84-05270

HARDSHIP REGULATIONS OUTSIDE SECTION 9, PARAGRAPH 6 OF THE WASTEWATER TAX LAW (HARTEREGELUNGEN AUSSERHALB DES SEKTION 9 ABS. 6 ABWAG),
For primary bibliographic entry see Field 5D.
W84-05273

6F. Nonstructural Alternatives

OPTIMAL OPERATION OF MULTIPLE RESERVOIR SYSTEMS,
Texas Dept. of Water Resources, Austin. Engineering and Environmental Systems Section.
For primary bibliographic entry see Field 4A.
W84-04956

CURRENT WATER ISSUES,
Resources for the Future, Inc., Washington, DC. Renewable Resources Div.
K. D. Frederick.
Journal of Soil and Water Conservation, Vol. 39, No. 2, p 86-91, March-April, 1984. 2 Fig, 11 Ref.

Descriptors: *Water resources development, *Management, Planning, Water demand, Legislation, Regulations, Federal jurisdiction, Public rights, Legal aspects, Doctrine of Prior Appropriation, Saline water intrusion.

Water needs tend to be location- and time-specific and these needs often do not coincide with the availability of natural supplies. Quality of the supply is becoming an increasingly important consideration in assessing the adequacy of supplies for meeting future water needs. Threats to groundwater quality continue to grow and they will become

much more difficult to reverse. Efforts to locate potential sources of contamination by the end of 1982 turned up more than 80,000 pits, ponds and lagoons storing industrial, municipal, agricultural or mining wastes. In addition more than 16 million septic tanks regularly disperse effluent into the ground. Most of these sites are unmonitored. Saline water intrusion also poses a problem in coastal areas where groundwater pumping may allow the seawater to enter freshwater aquifers. State law and water institutions provide guidelines for sharing and using water. Recognition of the need for better groundwater management has led all western states except Texas to abandon the doctrine of absolute groundwater ownership. Most now follow the doctrine of prior appropriation. The basic principle is to grant groundwater permits when the use is beneficial and does not unduly affect prior users. The federal government plays an important role in determining how and where water is used through water projects, reservation of water rights for federal and Indian lands and for navigation, environmental regulations, and negotiation and enforcement of international or interstate compacts. Failure to develop institutions and policies capable of allocating scarce water resources efficiently among competing uses and failure to protect supplies from abuse underlie the nation's water problems. (Baker-IVI)
W84-05053

UTILIZATION OF THE RESULTS OF WASTEWATER TAX CONTROL TESTING FOR OTHER PURPOSES (VERWENDUNG VON ERGEBNISSEN DER ABWASSERABGABENUBERPRUFUNGEN ZU ANDEREN ZWECKEN),
H. Keune.
Wasser, Luft und Betrieb, Vol. 27, No. 3, p 20-21, March 1983. 17 Ref.

Descriptors: *Water law, *Water quality standards, *Wastewater composition, *Wastewater pollution, *Wastewater management, *Wastewater tax control, *Wastewater analysis, Water quality control, Administration, Administrative decisions, Administrative regulations.

In the Federal Republic of Germany, the consequences of a company violating standards for wastewater discharge can be numerous. The results of testing wastewater discharge serve to maintain the standards according to the wastewater tax law. The Water Conservation Law (WCL) states that a water user who has employed a water-conservation expert found not to be discharging his duties satisfactorily can be required to find a new water-conservation expert. Only the water user has the right to appeal this ruling to the water authority. The water authority may impose a fine in addition to or instead of such admininstrative procedures. In any case, the authority is obliged to hear the appeal of the user. According to the state law of Nordrhein-Westfalen, a fine may be imposed for a variety of reasons. If conditions mean that the wastewater discharger has to violate standards, he must notify the authority before he begins to do so in order to avoid penalty. Other West German states have not copied this law. If the violation of regulations is severe enough to warrant criminal proceedings, the state attorney's office (SOA) is responsible, for investigating the case and is obligated also to look for exonerating circumstances. SAO investigations should also include the circumstances that will determine the sentence. The SAO may demand information about a company from any public authority. (Gish-IVI)
W84-05270

MULTIPLE PAYMENT FOR PREEXISTING POLLUTION (MEHRFACH-BEZAHLUNG DER VORBELASTUNG),
G. Schulz.
Wasser, Luft und Betrieb, Vol. 27, No. 4, p 26, April 1983. 2 Ref.

Descriptors: *Payment, *Multiple payment, *Preexisting pollution, *Water pollution sources, *Water quality management, *Pollution taxes, Economic aspect, Tax rates, Mathematical equations.

The wastewater tax law in the Federal Republic of Germany distinguishes between two deductions for preexisting pollution in the receiving stream: the initial (basic) deduction, which applies only to suspended solids and COD; and the prepollution deduction, applicable to parameters relevant to wastewater effluent. Most states in the Federal Republic do not recognize additive consideration of prepollution, which gives them an unjustified advantage. The problem is that preexisting pollution (e.g., 5 mg COD/l) in a river is picked up by each user and is passed onto the next; it is usually not removed by wastewater treatment as it mainly consists of biologically and chemically inert matter, e.g., humic acid. Each user pays with his wastewater tax for pollution that upstream users have already paid for. In addition, downstream users are paying for extra pollutants introduced and paid for by upstream users that raise the level of preexisting pollution for the former. This phenomenon can be expressed mathematically. (Gish-IVI)
W84-05271

ROLE OF MACROPHYTES IN AQUATIC ECOSYSTEMS AND MANAGEMENT OF FRESHWATER RESOURCES,
Kashmir Univ., Srinagar (India). Centre of Research for Development.
For primary bibliographic entry see Field 5A.
W84-05306

6G. Ecologic Impact Of Water Development

PRELIMINARY STUDY OF THE EFFECTS OF IMPOUNDMENT OF LG-2 RESERVOIR (JAMES BAY TERRITORY, QUEBEC) ON THE NET SESTON AND THE ZOOPLANKTON OF IMPOUNDED RIVERS AND LAKES (ETUDE PRELIMINAIRE DES EFFETS DE LA MISE EN EAU DU RESERVOIR DE LG-2 (TERRITOIRE DE LA BAIE JAMES, QUEBEC) SUR LE SESTON GROSSIER ET LE ZOOPLANKTON DES RIVIERES ET DES LACS INONDES),
Montreal Univ. (Quebec). Centre de Recherches Ecologiques.
B. Pinel-Alloul, and G. Methot.
Internationale Revue der Gesampten Hydrobiologie, Vol. 69, No. 1, p 57-78, 1984. 7 Fig, 6 Tab, 41 Ref.

Descriptors: *Reservoirs, *Zooplankton, *Seston, *Ecological effects, *James Bay Territory, Quebec, River La Grande, Environmental impact statement, LG2 reservoir, River basin development, Water resources development, Bacterioplankton, Allochthonous organic matter, Food chains.

The effects of impoundment on the biomass of net seston and zooplankton in lakes and rivers of Northern Quebec were investigated from 1978 to 1980, before, during and after the completion of LG2 Reservoir on the River La Grande. In lotic stations, a 41-77% decrease in net seston was observed due to sedimentation of mineral particles (36-80 mg/cu m in 1978 to 10-21 mg/cu m in 1979). The ratio of organic to total seston increased from an average of 0.18 before the impoundment to 0.65 after. The flooding phase brought about a trophic upsurge; the biomass of the zooplankton increased by one to two orders of magnitude at the various sites; the greatest increases occurred in the central station near the dam, the smallest in the upper stations near the inflow. In lake stations, no significant difference between years could be detected; the mean zooplankton biomass for all three years ranged from 6.59 mg/cu m to 34.34 mg/cu m. Spatial variations between lakes were however significant. Results are compared with those in other natural lakes in Canada and reservoirs in the United States. Comparative examination of phytoplankton biomass before and after impoundment of LG2 Reservoir suggests that bacterioplankton and allochthonous organic material are key elements in the pelagic food chain after impoundment. (Murphy-IVI)
W84-04894

ANTHROPOGENIC EFFECTS ON THE FISH POPULATION (ANTHROPOGENE EINWIRKUNGEN AUF FISCHBESTANDE),
Galati Univ. (Romania).
For primary bibliographic entry see Field 5C.
W84-04912

ENVIRONMENTAL ANALYSIS IN HYDROPOWER LICENSING: A MODEL FOR DECISION MAKING,
American Univ., Washington, DC. School of Government and Public Administration.
N. Kerwin.
Environmental Impact Assessment Review, Vol. 4, No. 2, p 131-136, June, 1983.

Descriptors: *Environmental impact statement, *Hydroelectric power, *Decision making, Planning, Management, Water resources development, Environmental effects, Powerplants.

The Federal Energy Regulatory Commission (FERC) must consider a number of aspects of a proposed hydropower project including the need for the power it generates, its safety and the affected environment. The environmental dimension of licensing is outlined by a complex network of Federal statutes which estabishes both substantive and procedural obligations for FERC. Environmental reports prepared by developers are incorporated into applications for project licenses. When applications are deemed acceptable for processing, the staff determines what type of report they will issue on the proposed project. The decision not to develop an impact statement could be significant if it meant no further analysis would be done. There are strong incentives for all interested parties to engage in an analytical process that isolates key issues early and in dispute resolution to reach negotiated agreements. There are two general types of environmental conditions that can be attached to a license for a hydropower project. One type is included among the so-called L form or standard license articles. It includes general requirements to provide for recreation, to prevent soil erosion, to dispose of spoil from construction properly and to install and maintain stream gauges. The other type involves special environmental articles developed specifically for individual projects. The FERC environmental analysis is a process that has moved perceptibly toward the decision-making model that experts hoped would emerge from the analytical requirements of NEPA. (Baker-IVI)
W84-05010

EFFECTS OF DISSOLVED-OXYGEN DEPLETION ON THE RAINBOW TROUT FISHERY IN LAKE TANEYCOMO, MISSOURI,
Missouri Dept. of Conservation, Columbia.
A. S. Weithman, and M. A. Haas.
Transactions of the American Fisheries Society, Vol. 113, No. 2, p 109-124, March, 1984. 7 Fig, 4 Tab, 8 Ref.

Descriptors: *Lake Taneycomo, *Missouri, *Dam effects, *Trout, *Dissolved oxygen, Fisheries, Sport fishing, Fishing success, Catch rate, Economic aspects.

Lake Taneycomo, a 700-hectare hydroelectric impoundment in Taney County, southwestern Missouri, is fed by cool hypolimnetic waters from an upstream reservoir. A popular put-grow-and-take fishery for rainbow trout Salmo gairdneri has become established in Lake Taneycomo, but fishing success and effort decline each fall when oxygen-depleted water enters the lake. The fishery was examined in detail from June 1978 through May 1980. During this period, catch rates of rainbow trout averaged 0.55 fish/hour, and were influenced by dissolved-oxygen concentration, number of fish available to be caught, discharge rates from the upstream reservoir, angler experience, and water temperature. A decrease of 1 mg/liter dissolved oxygen, between 6.0 and 2.4 mg/liter, reduced catch rates by 0.1 fish/hour. During the fall, a change in catch rate of 0.1 fish/hour can result in a change of 20,000 hours of fishing at Lake Taneycomo. The expected annual economic loss to the Taney County economy due to low concentrations

of dissolved oxygen is $358,000 (range $267,000-$432,000). (Author's abstract)
W84-05082

HABITAT USE BY ADULT PADDLEFISH IN THE UPPER MISSISSIPPI RIVER,
Iowa Cooperative Fishery Research Unit, Ames.
P. D. Southall, and W. A. Hubert.
Transactions of the American Fisheries Society, Vol. 113, No. 2, p 123-131, March, 1984. 3 Fig, 4 Tab, 31 Ref.

Descriptors: *Fish behavior, *Mississippi River, *Paddlefish, Aquatic habitats, Tailwaters, Channels, Backwater, Invertebrate drift, Environmental effects.

Information on paddlefish habitat associations in the upper Mississippi River is useful because of continuing adverse effects on habitat by navigation, siltation, and industrial siting, as well as potential hydroelectric power development. Seventeen paddlefish were tracked in two pools (12 and 13) of the upper Mississippi River during the summer of 1980 and spring and summer of 1981. Interpool movement occurred during spring high water periods when dam gates were lifted to create a free-flowing river. Habitat use varied by season. Selection was greatest for tailwater and channel habitats, although strong association with one backwater slough was evident. Even when backwaters are not directly utilized, invertebrate drift from these areas may be important. Paddlefish often congregated near man-made structures that created eddies and reduced current velocities. (Baker-IVI)
W84-05083

STATUS OF RIPARIAN ECOSYSTEMS IN THE UNITED STATES,
New York State Dept. of Environmental Conservation, Delmar. Div. of Fish and Wildlife.
For primary bibliographic entry see Field 2A.
W84-05162

CHANGES IN DIATOM FLORA DEPOSITED ANNUALLY DURING THE FRESHENING OF THE IMPOUNDED, SEA-BAY OF GENNARBY-VIKEN IN SOUTHERN FINLAND,
Turku Univ. (Finland). Dept. of Quaternary Geology.
For primary bibliographic entry see Field 2L.
W84-05220

IMPINGEMENT OF FISHES AT THE INDIANAPOLIS POWER AND LIGHT COMPANY GENERATING STATION ON THE WHITE RIVER AT PETERSBURG, INDIANA,
Indiana State Univ., Terre Haute. Dept. of Life Sciences.
J. O. Whitaker, Jr.
Procedings of the Indiana Academy of Sciences, Vol. 92, p 213-217, 1982. 5 Tab, 4 Ref.

Descriptors: *Fish, *Powerplants, Impingement, Deicers, White River, Petersburg, Indiana, Screens, Inflow channels, Channels.

Seines were placed across the impingement outflow trough and all fish were collected during extended sampling periods. The total number, number per hour, and projected number per year of all species of fish taken in the impingement sample are provided. These totaled 10,772 individuals, of which 9784 (90.8%) were gizzard shad, followed by the channel catfish 444 or 4.1% and buffalo at 149, or 1.4%. A total of 32 separate species were found. Relatively few fish are generally impinged. Most of the fish taken in the impingement samples were relatively small, less than 6 in. total length. Many were 2-4 in. long. There was some indication that the deicer, when in operation, might be attracting some fish that otherwise would not have been impinged, but further study is needed to corroborate this theory. (Baker-IVI)
W84-05307

7. RESOURCES DATA

7B. Data Acquisition

CONSTRUCTION AND OPERATION OF A LARGE UNDISTURBED LYSIMETER TO MEASURE RECHARGE TO THE CHALK AQUIFER, ENGLAND,
Institute of Hydrology, Wallingford (England).
R. Kitching, and T. R. Shearer.
Journal of Hydrology, Vol. 58, No. 3/4, p 267-277, September, 1982. 5 Fig, 6 Ref. U. K. Dept. of the Environment Contract No. DR6/480139.

Descriptors: *Measuring instruments, *Lysimeters, *Groundwater recharge, *England, Aquifers, Water balance, Chalk aquifers.

A large lysimeter has been successfully constructed and operated to yield continuously experimentally measured values of recharge throughout the whole year. The method is completely independent of sophisticated theoretical models of the recharge mechanism and in particular does not rely on imputed values of evaporation determined from empirical or other equations. The lysimeter has proved generally reliable and has yielded good data with a minimum of manual involvement indicating that the technique is suitable for use in remote locations. Comparisons with the Cambridge Water Company's shallow turfed lysimeter at the same site indicate that there are some differences in the timing and quantity of the recharge. So far, the differences have not been excessive but the characteristics of these differences indicate that the optimal size for a lysimeter is somewhat greater, particularly in depth, than these installations. (Baker-IVI)
W84-04851

APPLICATION OF HOT-WIRE (-FILM) FLOWMETERS TO WATER VELOCITY MEASUREMENTS IN WELLS,
Imperial Coll. of Science and Technology, London (England). Div. of Engineering Geology.
For primary bibliographic entry see Field 2E.
W84-04858

FIELD SYSTEM FOR AUTOMATICALLY MEASURING SOIL WATER POTENTIAL,
Alabama Agricultural Experiment Station, Auburn.
For primary bibliographic entry see Field 2G.
W84-04880

DETERMINING SOIL-INDUCED PLANT WATER POTENTIAL DEPRESSIONS IN ALFALFA BY MEANS OF INFRARED THERMOMETRY,
Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.
For primary bibliographic entry see Field 2I.
W84-04970

COMPARISON OF WATER STRESS OF COTTON FROM MEASUREMENTS WITH THE HYDRAULIC PRESS AND THE PRESSURE CHAMBER,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2I.
W84-04981

CHUTE ENTRANCES FOR HS, H, AND HL FLUMES,
Agricultural Research Service, Stillwater, OK. Crop Production and Water Conservation Lab.
W. R. Gwinn.
Journal of Hydraulic Engineering, Vol. 110, No. 5, p 587-603, May, 1984. 13 Fig, 4 Tab, 6 Ref, 2 Append.

Descriptors: *Flumes, *Chute entrances, *Flow measurement, Open channel flow, Runoff, Sediments, Hydraulic jump, Turbulence, Mixing.

The HS, H, and HL flumes have a proven performance for measuring runoff from watersheds and flows in open channels. In order to reduce problems with ponding and sediment deposition, new chute entrances were designed for the flumes. The flumes were calibrated with the new chute entrances in place for both free and submerges outfall conditions. Sediment was fed into the flow to evaluate chute entrance and flume performance when conveying sediment-laden flows. In the HL flume with a flat floor approach the discharge ranged from 6.5% below published table values for low flows to almost no difference at the maximum head. Generalized discharge equations for HS, H, and HL flames with chute entrances are given. A direct solution for the effect of submergence on HL flumes is presented in equation form. The hydraulic jump which forms on the sloping floor of the chute for all flows causes turbulence in the jump which helps keep sediment in suspension and provides mixing for water quality measurements. The depth of ponding over the approach is reduced to half of what it would be if no chute were provided. Sand in the flow will deposit at the lower end of the chute and in the flume. Discharge corrections are provided for sediment concentrations less than 11,000 mg/L (1.1%) in the HS flume with chute entrance and collector trough. (Moore-IVI)
W84-05146

DOCUMENTATION OF HIGH SUMMER FLOWS ON THE POTOMAC RIVER FROM THE WOOD ANATOMY OF ASH TREES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-05165

TRENDS IN THE DEVELOPMENT OF HYDROMETRY,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
O. Starosolszky.
Hydrological Sciences Journal, Vol. 28, No. 1, 3, p 103-123, 1983. 16 Fig, 1 Tab, 14 Ref.

Descriptors: *Measuring instruments, *Hydrometry, Reviews, Turbulent flow, Currents, Flow discharge, Network design, Data processing.

Developments in the field of operational hydrology concerning reliable and accurate instruments and methods of observation are reviewed. In assessing the trends, the interconnections of hydrometry with network design and data processing are discussed. Three-dimensional flow phenomena in streams and lakes present a challenge to hydrologists. Several aspects should be studied in order to get a better understanding of the problem of flow measurement. Some of these aspects include: variation of the rating curve of measuring structures; measurement of spatial velocity vectors at great depths; measurement of three-dimensional turbulence and minimizing its affect on the uncertainty of current metering; assessment of the magnitude of velocity pulsations and identification of their sources; recognition of three-dimensional flow as a source of bias in discharge measurement; and assessment and reduction of the uncertainty of flow measurement in lakes, and clarification of the actual meaning of the values measured. (Baker-IVI)
W84-05301

SOIL-WATER FLUX SENSOR AND ITS USE FOR FIELD STUDIES OF TRANSFER PROCESSES IN SURFACE SOIL,
Oita Univ. (Japan).
H. Kawanishi.
Journal of Hydrology, Vol. 60, No. 1-4, p 357-365, January, 1983. 6 Fig, 3 Ref.

Descriptors: *Rainfall, *Soil water, Evapotranspiration, Chlorides, Temperature, Heat, Infiltration, Measuring instruments.

A soil-water flux sensor was developed to determine the flux value from the difference between

downstream and upstream temperatures at some distances from an artificial line source of heat placed at a right angle to the water flow. It can detect flux values ranging from several mm/hr to as small as 0.01 mm/hr. Design and calibration of the sensor are described. The sensor was applied to the field studies of transfer processes in a surface soil, including rainwater infiltration, upward soil water flow during evapotranspiration, and their effects on the water table level. A cylindrical container of polyvinyl chloride, 70 cm in diameter and in depth, was buried with its top out of the soil and was provided with the same soil and the same grass cover as the surroundings. Groundwater table reached near the surface just after a heavy rain and descended gradually during a spell of fine weather. Observations of soil-water flux, soil-water content and water-table depth were carried out with the soil in the container. The soil-water flux sensor was buried just below the root zone at a depth of 15 cm. Soil was sampled at several depths to 15 cm, to determine the volumetric contents of water and solutes. The water table depth was recorded with a float type water level gauge. The evapotranspiration rate was determined by the heat balance method. Chloride ion accumulation in the surface soil is discussed on the basis of upward water flux and chloride content observed. (Baker-IVI)
W84-05366

EVAPORATION DATA FROM A PICHE EVAPORIMETER,
Agricultural Univ., Wageningen (Netherlands). Dept. of Physics and Meteorology.
For primary bibliographic entry see Field 2D.
W84-05367

7C. Evaluation, Processing and Publication

LINEAMENTS AND FRACTURE TRACES, DECATUR COUNTY, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
T. K. Greeman.
USGS Open-File Report 82-918, 1983. 18 p, 4 Fig, 14 Ref.

Descriptors: *Aquifer characteristics, Drilling, *Geological fractures, Groundwater movement, Potential water supply, *Fracture trace, *Lineament, Limestone-dolomite aquifer, Well-site selection, Drift fractures, *Indiana, Decatur County.

Lineaments and fracture traces were mapped in Decatur County. Observed throughout the county, these features overlie vertical bedrock fractures. Wells drilled on these mapped features may yield adequate supplies for domestic and larger needs. Two nearly horizontal sequences of mid-Paleozoic limestone and dolomite, separated by a thin discontinuous shale unit, constitute the principal aquifer. Many wells in this aquifer fail to supply household needs, whereas others are used for municipal supply. Wells in the aquifer have been located for the owner's convenience and are randomly located in relation to lineaments and fracture traces. Pleistocene glacial drift, averaging about 150 feet thick, did not restrict lineament and fracture-trace mapping. Well placement is very important in this area, as fractures are a principal source of water to wells. In fractured bedrock areas, the most productive well locations are at mapped lineament or fracture-trace intersections and at the lowest local altitude. Use of the lineament and fracture-trace map will not guarantee a sufficient ground-water supply, but will minimize the chance of drilling an inadequate well. (USGS)
W84-04806

SOME METHODS FOR TESTING THE HOMOGENEITY OF RAINFALL RECORDS,
Royal Netherlands Meteorological Inst., De Bilt.
T. A. Buishand.
Journal of Hydrology, Vol. 58, No. 1-2, p 11-27, August, 1982. 8 Fig, 4 Tab, 17 Ref.

Descriptors: *Rainfall, *Homogeneity, *Netherlands, Mathematical equations, Data collections, Cumulative deviation.

Cumulative deviations from the mean are often used in the analysis of homogeneity of rainfall records. Features of five tests on the cumulative deviations are discussed. Some of these tests have optimal properties in testing the null hypothesis of homogeneity against a shift in the mean at an unknown point. As a first example two tests on the rescaled adjusted partial sums were introduced. Weighted cumulative deviations were discussed to emphasize changes near the end-points of the sequence. Worsley's likelihood ratio test for a shift in the mean in normal populations is equivalent to a test on the weighted adjusted partial sums. Bayesian procedures for testing a change in level were described. The resulting test-statistics are simple quadratic forms of the rescaled adjusted partial sums. The data generation method showed that tests on the cumulative deviations are superior to the classical von Neumann ratio for a model with only one change in the mean. The tests were applied to annual data for 264 rainfall stations in The Netherlands. There was strong evidence of departures from homogeneity. The von Neumann ratio gave nearly the same results as the tests on the cumulative deviations. (Baker-IVI)
W84-04836

8. ENGINEERING WORKS

8A. Structures

OPTIMAL DIAMETER SELECTION FOR PIPE NETWORKS,
Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
R. E. Featherstone, and K. K. El-Jumaily.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 221-234, February, 1983. 4 fig, 6 Tab, 9 Ref.

Descriptors: *Optimization, *Pipe diameters, *Pipelines, Systems analysis, Network design, Pipe distribution networks, Mathematical equations, Operating costs.

A new approach to the least cost design of water distribution networks has been developed. The method is based on traditional techniques of pipe networks analysis by computer; initially assumed pipe diameters are successively adjusted using an optimization technique which is based on a cost function incorporating the various capital and operating costs. Final design total costs for a given network have been found to be approximately the same regardless of the initially assumed values of pipe diameter although the final arrangements of pipe diameter are not necessarily identical. Since the method considers all physical components of the network, both from the point of view of the flow and pressure distribution and the costs, the design represents the global optimum as opposed to a typical element optimum which has been considered by other workers. The method contains no constraints such as assumed fixed pressure heads or pipe flows and may be applied to either closed loop or open loop networks of any size. Provided a computer program for analyzing pipe networks is available, the optimization technique developed represents a simple addition to the basic program. (Author's abstract)
W84-04830

IDEAL RESERVOIR CAPACITY AS A FUNCTION OF YIELD AND RISK,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.
M. Bayazit.
Journal of Hydrology, Vol. 58, No. 1/2, p 1-9, August, 1982. 12 Fig, 4 Ref.

Descriptors: *Reservoir capacity, *Deficit, *Yield, *Risk, Statistical analysis, Flow, Storage reservoirs.

Deficit represents the capacity of an ideal storage reservoir, which is allowed to spill, that can regulate the flow to supply a certain yield along a given period of time. Its statistical properties have been determined in this study by means of the data generation method. Simulation experiments have led to the conclusion that the standard form of the deficit has a unique distribution, whatever values the level and period of regulation, and autocorrelation coefficient of inflows have. Mean and standard deviation of the deficit have been determined as functions of the above variables. By means of the diagrams provided it is possible to determine the size of an ideal reservoir constant yield over a certain period of time with a given level of risk when it is assumed that flows into the reservoir constitute a first-order autoregressive process. (Baker-IVI)
W84-04835

RIVER LOCK REHAB: A WINTER'S TALE,
Harza Engineering Co., Chicago, IL.
J. T. Passage, and J. H. Plump, Jr.
Civil Engineering, Vol. 54, No. 5, p 44-47, May, 1984. 6 Fig.

Descriptors: *Dam construction, *Rehabilitation, *Locks, *Mississippi River, Safety, Construction, Blasting, Costs, Cold weather construction.

Lock and Dam No. 1 between St. Paul and Minneapolis on the Mississippi River had deteriorated past the point of safety and steps were needed to allow safe operation and at the same time not interrupt the summer flow of river traffic. Lock rehabilitation required a new filling and emptying system, replacement of deteriorated concrete, installation of post-tensioned anchors through the lock walls for stability, plus complete replacement of operating machinery, power supply and control systems. The apron slab of the overflow spillway dam also required anchoring with post tensioned anchors and the replacement of some deteriorated concrete. Turbulence had to be reduced in the lock chamber during filling and downstream of the lock during emptying in order to improve hydraulic efficiency and increase safety. Controlled blasting was used to carefully remove the concrete in the culverts, to replace the face of the lock walls and to remove monoliths of concrete as large as 30 ft wide, 30 ft deep and 60 ft high, necessary to modify the filling and emptying system. Before rehabilitation, discharge from the land wall was directed across the navigation channel and discharge from the center wall flowed straight down the channel, causing considerable turbulence in the areas where commercial vessels and pleasure craft wait to approach the locks. Modifications were made to this procedure. The locks and dam were rehabilitated for a final design and construction cost of $45 million - less than a quarter of the cost of a new structure. (Baker-IVI)
W84-04925

RECENT DEVELOPMENTS IN THE FIELD OF FRENCH ENGINEERING RELATING TO HYDRO-ELECTRIC GENERATION (LES RECENTS DEVELOPPEMENTS DANS LE DOMAINE DE L'INGENIERIE FRANCAISE EN MATIERE D'ENERGIE HYDROELECTRIQUE),
H. de Maublanc.
La Houille Blanche, Vol. 5/6, p 393-402, 1982. 5 Fig, 1 Tab.

Descriptors: *France, *Hydroelectric plants, *Civil engineering, Dam design, Hydraulic machinery, Dam construction, Computers, Construction methods, Intakes, Tunnel construction, Tidal energy.

In civil engineering in France, important developments in techniques have been made in: design (concrete dams, ski-jump spillways in narrow valleys, progress in the construction of arches in large valleys, use of confined flow spillways, embankment dams, sealing systems and the treatment of foundations); computations (use of computer and semi-probabilistic methods); construction (construction of mobile dams on dry land, and construction underwater without deponding the foundations). The design of water intake structures fitted with automatic scours has solved the prob-

lem of intake structures at high altitudes. Tunnelling machines are already in use in France on major projects, and are increasingly used for boring galleries and tilted shafts. For underground stations, developments have been in design, boring, and earth retaining techniques. Feasibility studies for tidal energy are presently underway. Recent developments in electromechanical equipment are chiefly linked to the enhancement of the characteristics of sets (unit power, head, rotational speed) and their operating mode (automatic systems and remote control, secondary regulation of frequency and voltage). Some progress has also been made in the generator motor field and confined flow conduits. (Moore-IVI)
W84-05018

INTEGRATED DEVELOPMENT OF A LARGE RIVER: THE RHONE; A. GENERAL DESIGN AND EFFECT ON FLOODS AND SUBSURFACE WATER LAYERS (L'AMENAGEMENT INTEGRE D'UN GRAND FLEUVE: LE RHONE; A. CONCEPTION GENERALE ET EFFETS SUR LES CRUES ET LES NAPPES PHREATIQUES),
Compagnie Nationale du Rhone, Lyon (France).
P. Savey.
La Houille Blanche, Vol. 5/6, p 421-426, 1982. 6 Fig, 3 Ref.

Descriptors: *Rhone River, *France, *Water resources development, Navigation, Hydroelectic plants, Agricultural development, Flood control, Drainage, Dredging, Groundwater management.

Responsibility for the development of 500 km of the French part of the Rhone is in the hands of the National Rhone Corporation (CNR). The operation is almost complete, with 16 of the 19 locations to be harnessed already in service. This is a multi-purpose development for hydroelectric generation, navigation, agricultural development, flood protection and development of port facilities. The Rhone has promising potential with a semi-permanent flow of 1460 cu m/s, conveying a average of 50 billion cu m per year. It produced 16.9 TWh in 1981. The navigable section completed as of 1981 is 350 km long and can handle the passage of 4,000 to 5,000 ton convoys. The waterway has been divided into 19 sections. The least land possible has been absorbed for each section in order to promote the development of the riverside economy. Special measures (dyking, dredging and automated operation) taken to ensure the offtake of floodwater, have produced a marked improvement over natural conditions. In addition, major drainage facilities have allowed for control of subsurface water layers in the valley for the needs of farming and riverside towns. The continuity of the work (spread over 30 years) and the fact that the CNR is both designer and operator, have made it possible for this development to benefit from the significant technological progress which has occurred in recent decades. (Moore-IVI)
W84-05019

INTEGRATED DEVELOPMENT OF A LARGE RIVER: THE RHONE; B. DEVELOPMENT OF ELECTRO-MECHANICAL EQUIPMENTS (L'AMENAGEMENT INTEGRE D'UN GRAND FLEUVE: LE RHONE; B. EVOLUTION DES EQUIPEMENTS ELECTROMECANIQUES),
Compagnie Nationale du Rhone, Lyon (France).
For primary bibliographic entry see Field 8C.
W84-05020

HYDRO-ELECTRIC RESOURCES OF THE PARANA RIVER IN BRAZIL (LES RESSOURCES HYDROELECTRIQUES DU PARANA BRESILIEN),
C. A. de P. Amarante.
La Houille Blanche, Vol. 5/6, p 451-460, 1982. 3 Fig, 3 Tab.

Descriptors: *Parana River, *Brazil, *Hydroelectric plants, Water resources development, Itaipu Project.

The hydrographic basin of the Parana river occupies 1,237,000 sq km of the most developed region in the center of Brazil. A full inventory was made over the 1960's which was the basis for its later development: the Parana is now harnessed by more than twenty large hydro-electric power stations in operation with a total installed power of 20,000 MW. Their main characteristics and the resources remaining to be harnessed will give an idea of the importance of the Parana river in the development of hydro-electric sites in Brazil. The Itaipu development presently under way (126,000 MW) is mentioned in particular as a joint project between Brazil and Paraguay. (Author's abstract)
W84-05021

WORKSITE OF THE GRAND'MAISON DAM (LE CHANTIER DE CONSTRUCTION DU BARRAGE DE GRAND'MAISON),
J. Cadot.
La Houille Blanche, Vol. 5/6, p 487-496, 1982. 5 Fig, 1 Tab.

Descriptors: *Grand'Maison Dam, *Dam construction, *Earthworks, *Rockfill dams, Cold weather construction, Alpine regions, Embankments, Construction equipment.

The Grand'Maison dam, at a height of 1700 m, is formed of an earth dyke and rockfill built up 160 m from the ground for a total volume of 125000000 cu m. The construction of the facility will take sixty-nine months of elapsed time, but the climatic conditions of this mountain site, which is snowed up most of the year, limits actual construction time to approximately 85 summer days each year. The seasonal character of the worksite has determined the organization of the work and the choice of the means used by the group of firms building the dam. The refilling embankments (rockfill upstream and screen downstream) are constructed using conventional earthwork equipment: pneumatic loading machine, hydraulic buckets on high-capacity caterpillars, and 50-ton dumpers. A 1250 m conveyor belt with a carrying capacity of 1500 tons/hour conveys the materials used for the core. It crosses a large ravine on a 90 m metallic gangway. The segregation of materials is avoided by the use of a specially designed large hopper. (Author's abstract)
W84-05023

PRESSURE AND SPEED MEASUREMENTS IN A CENTRIFUGAL FAN (ROTOR AND STATOR) BEFORE AND AFTER THE APPEARANCE AND DISAPPEARANCE OF ROTATING STALLS (MESURES DE PRESSIONS ET DE VITESSES DANS UN VENTILATEUR CENTRIFUGE (ROTOR ET STATOR) AVANT ET APRES L'APPARITION ET LA DISPARITION DES DECOLLEMENTS TOURNANTS),
Ecole Nationale Superieure des Arts et Metiers, Lille (France).
B. Desmet.
La Houille Blanche, Vol. 2/3, p 167-174, 1982. 19 Fig, 10 Ref.

Descriptors: *Rotating stalls, *Hydraulic models, *Centrifugal pumps, Turbines, Impeller blades, Discontinuity, Rotation speed, Flow structure.

A centrifugal fan research facility was designed for pressure measurements on impeller blades. At low flow rates, a zone of discontinuity can be observed in the variation of head coefficient, power coefficient, and efficiency with the flow coefficient. The frequency response of the blade pressure measuring device was determined experimentally using the time response to a pressure step. the blade pressure fluctuations increase when the rotating stall appears, especially on the suction side at the inlet of the blade. Relative rotation speed of the rotating stall is deduced from the frequency analysis of pressure flutuation. The number of stall zones and the ratio of rotation speed of the rotating stall to that of the impeller as a function of the rate of flow is studied using one or two hot wire probes, placed at the impeller inlet, checking that the characteristics do not change when the fan rotates at a speed between 1000 and 2500 r.p.m. The blade to blade to blade distribution of speeds at impeller outlet over the whole width of the channel is obtained by using a probe with two hot wires. The flow structure with jet and wake can be observed at the center of the channel and the flow is more uniform near the hub and shroud. (Moore-IVI)
W84-05029

ESTIMATING GATE WEIGHTS,
Internacional de Engenharia, Rio de Janeiro (Brazil).
P. C. Erbiste.
International Water Power and Dam Construction, Vol. 36, No. 5, p 18-23, May, 1984. 7 Fig, 9 Tab, 5 Ref.

Descriptors: *Gates, *Weight, Dam construction, Construction, Estimating, Spillway gates, Fixed wheel gates, Tainter gates, Stoplogs, Flap gates.

A method is described for estimating the weight of gates based on their nominal dimensions and the head on the sill. Data are included on new types of gates. The gate weight directly affects the capacity of the hoisting equipment, and the final cost of supply to a construction project is generally estimated on the basis of the total weight of the equipment, of which the weight of the gate is the biggest concern. In order to determine the weight of the gate it is necessary to calculate the hydraulic forces, loading on members, working stresses, bolted and welded connections, pivots and supports and last, the gate weight. Equations are provided in this paper for estimating the weight of the following types of gates: spillway and submerged tainter gates, fixed-wheel gates, double-leaf fixed wheel gates, spillway and submerged stoplogs and flap gates. For each type an expression involving only the nominal gate dimensions and the head on the sill is developed, as these are generally the only defined characteristics at the start of a project. (Baker-IVI)
W84-05098

USE AND RE-USE OF ITAIPU'S DIVERSION GATES,
Itaipu Binacional, Rio de Janeiro (Brazil).
J. R. Villalba, R. C. Monteiro, A. E. Raiunec, J. H. Gummer, and J. P. Baroux.
International Water Power and Dam Construction, Vol. 36, No. 5, p 24-28, May, 1984, 9 Fig, 1 Tab.

Descriptors: *Dam construction, *Diversion, *Gates, *Itaipu, Design criteria, Planning, Water management, Flow, Construction, Parana River, Intake gates.

The choice of materials for Itaipu's diversion gates, their design and mode of construction are described, as well as the operation to recover them after diversion closure for re-use as intake gates. The diversion structure and its associated sluices were designed in such a way that for a maximum flow of 35,000 cub m/sec, the main upstream cofferdam at el. 140 m would not be overtopped and the velocity in the sluices would not exceed 15 m/s to limit any possible cavitation or abrasion damage. Also the design of the diversion had to allow for the riparian rights in the Parana River to be maintained during closure. In the initial scheme the diversion gates were to be used solely for diversion and left in place after closure and permanent concrete plugs were to be placed in the diversion sluices. However, as the design of the gates progressed, it was realized that substantial savings could be made if the gates were rehabilitated and subsequently used in the power intakes. (Baker-IVI)
W84-05099

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS; 1. A STOCHASTIC SEDIMENT STORAGE MODEL,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
E. F. Soares, T. E. Unny, and W. C. Lennox.
Journal of Hydrology, Vol. 59, No. 1-2, p 49-82, October, 1982. 5 Fig, 14 Tab, 24 Ref, 3 Append.

Descriptors: *Stochastic process, *Sediment storage, *Reservoir silting, *John Martin Reservoir,

*Colorado, Dam effects, Model studies, Sediment deposition.

When a dam is constructed in a natural water course to store water, it changes the hydraulic characteristics of flow immediately upstream of the dam and, consequently, the sediment-transport capacity. Sedimentation of the reservoir created by the dam is then inevitable, reducing the storage capacity of the reservoir. In planning reservoirs, it is necessary to predict not just the probable amount of total sediment stored, but also how this stored sediment is distributed along the reservoir. A stochastic model is developed to predict the deposition of sediment in reservoirs as a function of time in years. The cumulative deposition of sediment in time is an additive process defined on a finite Markov chain. The model is analyzed to obtain the mean and the range of the cumulative deposition as a function of discrete time in years. The model is applied to describe the sediment storage in the John Martin Reservoir, on the Arkansas River in Colorado. The reservoir was constructed for flood control and irrigation. The sediment accumulated in the reservoir at the end of each water year as computed by the suspended load at inflow and outflow stations from the years 1943-1966, and the sediment accumulated in the reservoir as computed from sediment surveys are compared. The stochastic model is capable of predicting the cumulation of sediment deposition in the reservoir. The measured values are found to be derived from a population that has the expected value and variance specified by the model. (Moore-IVI)
W84-05127

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS: 2. DETERMINISTIC MODEL FOR THE SEDIMENT DEPOSITION PROCESS,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
E. F. Soares, T. E. Unny, and W. C. Lennox.
Journal of Hydrology, Vol. 59, No. 1-2, p 83-105, October, 1982. 7 Fig, 29 Ref.

Descriptors: *Reservoir silting, *Model studies, *Sediment deposition, Deterministic models, Distribution, Dam effects, Stochastic process, Sediment storage.

The stochastic model developed in Part 1 could be use to determine the distribution of sediment along the length of the reservoir, if the quantity of sediment deposited in a time period was determined as a function of the length measured from the upstream end of the reservoir. This functional relationship is formulated by developing a mode describing the unsteady free-surface flow of sediment-laden water over a loose bed. The governing equations are solved using an implicit finite-difference scheme. The pattern of deposition is a function of the inflow and the concentration of sediment in the inflow as well as the initial level in the reservoir and the initial composition of the sediment. The inflow in the reservoir is treated as unsteady and non-uniform. As much of the physical characteristics of the reservoir as possible is included in the analysis. (Moore-IVI)
W84-05128

CONJUNCTIVE USE OF DETERMINISTIC AND STOCHASTIC MODELS FOR PREDICTING SEDIMENT STORAGE IN LARGE RESERVOIRS; 3. APPLICATION OF THE TWO MODELS IN CONJUNCTION,
Pontificia Univ. Catolica do Rio de Janeiro (Brazil).
E. F. Soares, T. E. Unny, and W. C. Lennox.
Journal of Hydrology, Vol. 59, No. 1-2, p 107-121, October, 1982. 4 Fig, 11 Tab, 4 Ref.

Descriptors: *Reservoir silting, *Sediment deposition, *Model studies, *John Martin Reservoir, *Colorado, Stochastic process, Deterministic models, Sediment storage, Distribution, Dam effects.

The John Martin Reservoir is located on the Arkansas River in Bent County, Colorado. It is a multiple-purpose reservoir project constructed for flood control and irrigation. The stochastic sediment storage model developed in Part 1, in spite of the simple inflow representation adopted, predicted satisfactorily the total volume of sediment deposition as a function of time for the reservoir analyzed. In order to apply the model to predict sedimentation in new reservoirs, the parameters characterizing the inflow and the concentration of sediment in the inflow are required. These parameters can be easily evaluated if necessary measurements are carried out before the construction of the dam. The deterministic model developed in Part 2 appears, in the light of results obtained, adequate. This model may be used separately in unsteady non-uniform flow analysis with sediment discharge. A method has also been detailed to obtain the valid initial values for the problem. The combined deterministic-stochastic model satisfies the requirements for a realistic prediction of sediment distribution required for design of large reservoirs. (Moore-IVI)
W84-05129

BREACHING CHARACTERISTICS OF DAM FAILURES,
Leedshill-Herkenhoff, Inc., San Franciso, CA.
T. C. MacDonald, and J. Langridge-Monopolis.
Journal of Hydraulic Engineering, Vol. 110, No. 5, p 567-586, May, 1984. 3 Fig, 3 Tab, 56 Ref, 2 Append.

Descriptors: *Dam failure, *Computer programs, *Earth dams, Dam breaches, Safety, Dam stability, Erosion.

Computer programs have been developed that simulate dam break hydrographs, and route these hydrographs downstream so that inundated areas, flow depths, and flow velocities can be estimated. The programs are dependent on certain inputs regarding the geometric and temporal characteristics of the dam breach. Data on 42 historical dam failures were collected and analyzed to develop relationships which would form the basis of a methodology for estimating the geometric and temporal characteristics of breaches. Both earthfill dams, in which breaches are formed by erosion of the embankment material, and non-earthfill dams, that may have failed partly due to erosion and partly due to sudden collapses caused by instabilities, were studied. For both types of dams, the breach shape can be assumed to be triangular with 2V:1H side slopes if the breach does not extend to the base of the embankment and trapezoidal with 2V:1H side slopes if additional material is washed away after the breach reaches the base of the embankment. A methodology was developed for estimating the geometric and temporal characteristics of breaches in earthfill dams. These characteristics and methodology are compatible with existing computer programs and can be used in dam safety studies to estimate outflows from hypothetical dam failures. (Moore-IVI)
W84-05145

DEVELOPMENT OF THE WESTERN TIGRIS-BASIN IN TURKEY (AUSBAU DES WESTLICHEN TIGRIS-BECKENS IN DER TURKEI),
9 Eylul Univ., Izmir (Turkey). Dept. of Engineering and Architecture.
For primary bibliographic entry see Field 4A.
W84-05237

HYDRAULIC AND OPERATIONAL ASPECTS FOR THE ENERGY RECOVERY CONCEPT APPLIED AT THE WATER RESERVOIR SCHONBUHL OF THE LANDESWASSERVERSORGUNG STUTTGART (HYDRAULISCHE UND BETRIEBLICHE ASPEKTE DER ENERGIERUCKGEWINNUNGS - ANLAGE SCHONBUHL DES ZWECKVERBANDES LANDESWASSERVERSORGUNG),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 8B.
W84-05247

TINAJONES PROJECT IN PERU (PART I) (DAS TINAJONES-PROJEKT IN PERU (TEIL I)),
Salzgitter A.G. (Germany, F.R.).
W. Strumm.
Wasserwirtschaft, Vol. 73, No. 9, p 275-278, 1983. 4 Fig, 2 Ref.

Descriptors: *Tinajones Project, *Peru, *Irrigation programs, Drainage, Reservoirs, Canals, Diversion structures, Water resources development.

The Tinajones project in the north of Peru must be viewed as one of the most important irrigation schemes in South America. The first phase of this project is now approaching completion. A reservoir with a capacity of 300 million cu m, appurtenant structures, and intake and outlet canals to exploit the available water resources, and also transandean diversions to increase the annual amount of water have already been finished, thus ensuring that water can be provided for an irrigation zone of around 60,000 ha. A large part of the proposed structures in the irrigation and drainage area have also already been completed. This paper gives a review of this project and describes some of the problems encountered along the way. (Author's abstract)
W84-05250

TINAJONES PROJECT PART II (DAS TINAJONES-PROJEKT TEIL II),
Salzgitter A.G. (Germany, F.R.).
W. Strumm.
Wasserwirtschaft, Vol. 73, No. 10, p 344-348, October 1983. 3 Fig, 3 Tab, 2 Ref.

Descriptors: *Tina Jones Project, *Irrigation programs, *Peru, *West Germany, Reclaimed water, Water supply development, Water supply systems, Water resources development, Saline water intrusion, Irrigation canals, Canal construction, Foreign Construction, Tunnel construction, Construction costs, Optimum development plans, Water management, Conchano River, Chotano River, Chancay River, Amazon catchment.

The aspects of the West-German-Peruvian Tina Jones irrigation Project in northern Peru are described. Construction of drainage channels in the irrigated area was necessary due to salt accumulation: in 1980, about 30% of the area suitable for agriculture had suffered damage by salt. In the Ferrenafe sector, 271.8 km of drainage channels and sewers were built between 1977 and 1981 at a cost of 16.5 million dollars by a Peruvian company. In the Mochumi subsector, a Peruvian firm built 29.0 km of drains for approximately 1.0 million dollars in 1980/81 with the assistance of a German construction supervisor. Drains in the Lambayeque sector totaled 168.4 km and cost 12.0 million dollars. In addition, a series of irrigation measures, which would cost about 1.0 million dollars were recommended, even though the concept of the project did not include supplementary irrigation. Construction of a 4.2-km tunnel to divert water from the Conchano River in the Amazon catchment area to the Chotano, which flows into the Pacific Ocean, provided water for 8,000 ha of land. The tunnel has an inner diameter of 2.5 m and a minimal flow of 13.0 cu m/sec; it was built in 1973-75 at a cost of about 27.0 million dollars; German advisors included an engineer-geologist, a tunnel builder, and a grouting expert. The key structure for Stage II of the project, diverting water from the Chotano to the Chancay River, was completed in 1956 after 7 yr of work. Severe erosion along its entire length was discovered in 1967, necessitating renovations of the tunnel (grouting; renewal and improvement of the floor) and associated structures. A Peruvian-German consortium undertook the work in 1980/81 at a cost of 16 million dollars. For the future, agricultural conditions in the Chancay valley must be optimized through reclamation of salt-damaged land, renovation of the irrigation system improvements within the agricultural industry and in marketing and credit, and optimal water-management planning. A German company is presently updating hydrological and water-management data and plans for Stage II, and is study-

ing the feasability of a reservoir for the Chotano catchment area. (Gish-IVI)
W84-05254

BUTTRESS POWER STATION NUBDORF ON INN (DAS PFEILERKRAFTWERK NUSSDORF AM INN),
Innwerk A.G., Nussdorf (Germany, F.R.).
L. Carl, and H. P. Hack.
Wasserwirtschaft, Vol. 73, No. 12, p 494-498, 1983. 8 Fig, 4 Ref.

Descriptors: *Buttress power station, *Nussdorf on Inn, *Inn River, Hydraulic efficiency, Hydraulic design, Hydraulic structures, Hydroelectric plants, Engineering aspects.

The new power plant of the Innwerk AG near Nussdorf on the river Inn was built as a buttress power station contrary to the conventional block type arrangement which is normally used in the layout of run off river power plants. By using buttress power stations the total volume of the structure and the settlements are reduced. Further the factors of safety against sliding and overturning and the hydraulic efficiency may be improved. (Author's abstract)
W84-05266

DESIGN OF HIGH-PRESSURE TUNNEL OUTLETS (BESONDERE ASPEKTE DER GESTALTUNG VON GRUNDABLASSEN IN STOLLEN),
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
G. Anastasi.
Wasserwirtschaft, Vol. 73, No. 12, p 501-509, 1983. 12 Fig, 19 Ref.

Descriptors: *Hydraulic design, *Outlets, *San Roque Dam, Flow patterns, Flow profiles, Flow system, Concrete dams, Pressure depression, Shock waves, Air demand, Air entrainment, Design criteria, Hydraulic models, Philippines.

High-pressure outlets in tunnels give more design problems than common bottom outlets in concrete dams. This report deals with problems related to pressure depressions upstream of the gates, to shock waves in the tunnel, to air demand and air entrainment with particular emphasis on flow aeration. Design criteria for these matters are supported by the result of a hydraulic model study. (Author's abstract)
W84-05267

8B. Hydraulics

MEASURED SOIL RESPONSE TO EPB SHIELD TUNNELING,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
G. W. Clough, B. P. Sweeney, and R. J. Finno.
Journal of Geotechnical Engineering, Vol. 109, No. 2, p 131-149, February, 1983. 15 Fig, 1 Tab, 13 Ref.

Descriptors: *Earth pressure balance, *Infiltration, *Shield tunneling, Tunneling, Tunnel hydraulics, Tunnel construction, Soil water, Seepage, Groundwater control, Soil Engineering, Construction methods.

In the past decade, tunneling in soil has been plagued by rapidly rising costs associated with control of groundwater and by demands that ground movements induced by tunneling be kept to small levels. The first earth pressure balance (EPB) shield project in the United States, a 3,000 ft (915 m) long, 12.1 ft (3.7 m) diameter, tunnel is described. It is located in San Francisco and passes beneath a heavily trafficked commercial area known as Fisherman's Wharf. The soil profile consists of 20 ft (6.1 m) of rubble fill which overlies a 30 ft (9.1 m) layer of Bay Mud. A colluvium layer underlies the Bay Mud. The tunnel section is located within the Bay Mud, and has a cover of approximately 30 ft (9.1 m); water heads above the crown are typically 15 ft (4.5 m). The EPB shield was designed to deal with these difficult ground conditions without the use of compressed air or dewatering, and to cut through numerous abandoned wooden piles along the route. Surface and subsurface ground movements were monitored along the alignment during and after shield passage. The shield was found to initially heave the soil aside slightly as the face passed, but movements thereafter were towards the tunnel. Settlements were typically less than for conventionally shields and, the ground water table was unaffected by tunneling. (Murphy-IVI)
W84-04811

ANALYSES OF FLOW FAILURES OF MINE TAILINGS DAMS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 8D.
W84-04812

INVESTIGATION OF FLOW FAILURES OF TAILINGS DAMS,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 8D.
W84-04813

OPEN CHANNEL TRANSITIONS: RATIONAL METHOD OF DESIGN,
Roorkee Univ. (India).
N. Vittal, and V. V. Chiranjeevi.
Journal of Hydraulic Engineering, Vol. 109, No. 1, p 99-115, January, 1983. 6 fig, 2 Tab, 9 Ref.

Descriptors: *Open channels, *Design criteria, *Transition flow, Tranquil flow, Flow characteristics, Hydrodynamics, Flow profiles, Mathematical equations.

In engineering practice, it is often necessary to connect a channel of rectangular cross section (the flume) to a channel of trapezoidal cross section (the channel) or vice versa. The connecting section providing the gradual cross-sectional change is known as the transition. The design of transition calls for minimal hydraulic losses in the transition. Existing methods for the design of an open channel transition between a rectangular flume and a trapezoidal channel for subcritical flow have been critically examined. Arising out of some fundamental considerations, a suggestion has been offered to make Hinds transition design a direct method. The problem of flow through open channel transitions has been viewed basically from the fluid mechanics point of view and suitable functions for the boundaries of transition (namely bed width, bed elevation, and side slope) have been identified partly analytically and partly experimentally. Based on these results, a new and rational method of design is suggested. (Murphy-IVI)
W84-04826

AIR VOIDS AT DOWNSHAFT-TUNNEL BENDS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
B. T. Goldring.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 189-198, February, 1983. 7 Fig, 8 Ref.

Descriptors: *Air voids, *Downshaft-tunnel, *Tunnel hydraulics, Tunnel bends, Flow profiles, Hydrodynamics, Flow characteristics, Pipe flow, Pipelines, Mathematical equations, Prediction, Void space.

In closed conduit water flows containing a small amount of free air, an air void can form at a bend which connects a vertical shaft to a horizontal tunnel. A sudden reduction in the water flow rate can cause this void to vent back up the shaft. Tests were conducted on eight perspex pipe bends whose center-line radius varied from 0.5 times-1.5 times the pipe diam, and over a range of pipe diameters from 2.8 in.-7.5 in. (0.072 m-0.190 m). The air volumetric flow rate was up to 2% of the water volumetric flow rate. A combined theoretical and analytical approach yielded equations which can be used to predict void formation and venting at a downshaft-tunnel bend. Extrapolation of the results shows that these voids will not occur in large diameter bends with moderate air flows. (Author's abstract)
W84-04828

PLUME DILUTION FOR DIFFUSERS WITH MULTIPORT RISERS,
California Inst. of Tech., Pasadena. W.M. Keck Lab. of Engineering Materials.
M. S. Isaacson, R. C. Y. Koh, and N. H. Brooks.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 199-220, February, 1983. 9 Fig, 4 Tab, 11 Ref.

Descriptors: *Plume dilution, *Diffusers, *Multiport risers, *Design criteria, *Wastewater disposal, Wastewater dilution, Wastewater management, Plumes, Hydraulic models, Wastewater diffusers, Outfall, Performance evaluation, San Francisco, California.

A group of three new outfalls with multiport diffusers has been designed for the discharge of waste into the Pacific Ocean off the west side of the San Francisco peninsula near Lake Merced. The near field plume dilutions from ocean outfall line diffusers consisting of evenly spaced risers with clusters of two to eight ports per riser have been measured in a two-dimensional sectional hydraulic model. Tests were run under both idealized and measured ocean current and stratification conditions. A mathematical model was successfully correlated with tests not involving ambient currents, thus providing a useful design tool. The laboratory results show that, for the cases studied, the initial dilution is at most a weak function of whether the discharge ports are clustered or evenly distributed along the diffuser, and that the minimum dilution increases with decreasing port size (limited, ultimately, to that of a line source). Therefore, the most cost effective design for riser equipped ocean wastewater diffusers may involve the smallest port diameters permitted by other design considerations, and clustering many ports per riser to decrease the number of risers needed. (Murphy-IVI)
W84-04829

VELOCITY DISTRIBUTION IN SMOOTH RECTANGULAR OPEN CHANNELS,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
K. V. N. Sarma, P. Lakshminarayana, and N. S. Lakshmana Rao.
Journal of Hydraulic Engineering, Vol. 109, No. 2, p 270-289, February, 1983. 12 Fig, 3 Tab, 29 Ref.

Descriptors: *Velocity distribution, *Smooth rectangular open channels, *Open channels, Hydrodynamics, Flow characteristics, Model studies, Formulation of velocity model, Turbulent flow.

The theoretical investigations of Prandtl and Von Karman on flow through pipes, and the experimental studies of Nikuradse have led to rational formulas for velocity distribution and hydraulic resistance for turbulent flows over flat plates and in circular pipes. Velocity distribution in a smooth rectangular channel is studied by dividing the channel into four regions. Region 1 comprises the inner region of the bed and the outer region of the side wall. Region 2 belongs to the inner regions of both the bed and the side wall. Region 3 consists of the inner region of the side wall and the outer region of the bed. Region 4 forms the outer regions of both the bed and the side wall. The aspect ratio is varied from 2.0 to 8.0 and the Froude number from 0.2 to 0.7. Experiments included the aspect ratio of 1.0 also for Froude numbers of 0.2 and 0.3. The range of Reynolds number defined in terms of the hydraulic radius and the cross sectional mean velocity lies between 100,000 and 700,000. (Murphy-IVI)
W84-04831

HYDRAULICS OF STRUCTURES FOR CROSSING RIVER VALLEYS (HYDRAULIQUE DES OUVRAGES DE FRANCHISSEMENT DES VALLEES FLUVIALES),

Electricite de France, Chatou. Direction des Etudes et Recherches.
G. Nicollet.
La Houille Blanche, Vol. 4, p 289-308, 1982. 36 Fig, 1 Tab, 32 Ref.

Descriptors: *Hydraulic engineering, *Hydraulic design, *Bridges, Hydrodynamics, Hydraulic properties, Big Sioux River, Logone River, Rhone River, Hydraulic similitude, Performance evaluation, Hydraulic structures.

Problems associated with hydraulic aspects for structures across waterways and the definition of the broad lines of a projected structure across waterways is presented. The study offers practical solutions for determining the maximum raising point of the upstream water tract due to narrowing and the risks of non-stable flow, establishing predictions of errosion of underminable beds, general trend of the riverbed, local erosion due to the abutments and piers, and means of protection. Examples using the bridges of Pouzin over the Rhone River, Moundou over the Logone and a bridge over the Big Sioux River are presented. (Murphy-IVI)
W84-04946

SURVEILLANCE AND REINFORCEMENT OF FOUNDATIONS FOR STRUCTURE IN AQUATIC SITES THE HYDRAULIC ASPECT (SURVEILLANCE ET CONFORTEMENT DES FOUNDATIONS D'OUVRAGES D'ART EN SITE AQUATIQUE ASPECT HYDRAULIQUE),
Laboratoire National d'Hydraulique, Chatou (France).
M. Ramette.
La Houille Blanche, Vol. 1, p 41-48, 1982. 22 Fig.

Descriptors: *Hydrodynamics, *Hydraulic properties, *Flow around objects, *Flow characteristics, Design criteria, Hydraulic structures, Obstruction to flow.

Natural occurring phenomena in a river are described along with the effects structures (bridges, dykes, sills, etc.) have on this phenomena. A new state of equilibrium of the river is then defined. The possible aggressive phenomena, which was unpredicted during the design stage, that may compromise the stability of the structure was reviewed in an attempt to define the general principles for the appropriate countermeasures. (Murphy-IVI)
W84-04950

COMPARISON OF MANUAL WAVE PREDICTION MODELS,
National Water Research Inst., Burlington (Ontario). Shore Processes Section.
C. T. Bishop.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 1, p 1-17, February, 1983. 6 Fig, 3 Tab, 16 Ref.

Descriptors: *Fetch, *Waves, *Lake Ontario, Wind, Mathematical models, Donelan model, JONSWAP model, SMB model, Wave models, Prediction.

The predictions of three wave models have been compared with fetch limited, pseudo steady-state wave data measured at two locations on Lake Ontario in 1972. The accuracies of the Donelan, JONSWAP, and SMB models seem to be comparable, with standard errors of about 0.8 ft (0.25 m) in predicting characteristic wave heights and about 0.6 s in predicting the periods at the peak of the wave energy spectra. The accuracy of the Donelan model is somewhat better than that of the other two models. Moreover, the Donelan model provides an estimate of the peak wave energy direction rather than simply assuming coincident wind and wave directions. Therefore, this model should prove particularly useful for engineering application in steady fetch-limited conditions. (Baker-IVI)
W84-04959

DESIGN OF INLAND NAVIGATION FAIRWAYS,
Waterloopkundig Lab., Delft (Netherlands). Rivers and Navigation Branch.
H. G. Blaauw, and H. J. Verhey.
Journal of Waterway, Port, Coastal and Ocean Engineering, Vol. 109, No. 1, p 18-30, February, 1983. 6 Fig, 13 Ref.

Descriptors: *Navigation canals, *Canal design, *Fairways, Design criteria, Economic aspects, Cost-benefit analysis, Bank protection, Model studies, Environmental effects.

A comprehensive systematic approach for the design of inland navigation fairways distinguishes three main phases: economic studies, initial design phase, and final design phase. Each of the phases is characterized by different research tools to be applied. The method itself has an iterative character in which cost-benefit analysis and or ranking matrices, or both, play an important role. An intense cooperation between specialists of various disciplines is necessary. Before starting the design process design requirements have to be formulated and each design phase requires its own research tools to be applied. At the end of each phase the generated alternatives are screened leading to one or more selected alternatives on the basis of cost-benefit analyses and ranking matrices or both; at the end of both initial and final design as well as the impact assessment study the results obtained are fed back to the modal split to check if the design requirements are still met. The design is not completed without paying thorough attention to fairway equipment and authority. The width of the fairway is taken into consideration in the iteration process. The costs of construction of bank protection decrease when the fairway width increases. The total costs of fairway dredging and construction bank protections can therefore be minimized. (Baker-IVI)
W84-04960

STATISTICAL STUDY OF PARTIAL FLOW CHARACTERISTICS OF CENTRIFUGAL PUMPS AND OF APPROXIMATE DETERMINATION OF THE CRITICAL FLOW (ETUDE STATISTIQUE SUR LES CARACTERISTIQUES A DEBIT PARTIEL DES POMPES CENTRIFUGES ET SUR LA DETERMINATION APPROXIMATIVE DU DEBIT CRITIQUE),
Ecole Nationale Superieure des Arts et Metiers, Paris (France).
R. Rey, P. Guiton, Y. Kermarec, and G. Vullioud.
La Houille Blanche, Vol. 2/3, p 107-120, 1982. 11 Fig.

Descriptors: *Pumps, *Centrifugal pumps, *Critical flow, Statistical studies, Partial flow.

Six pump manufacturers gathered as a sub-working group of the SHF helped to draw up statistics on the H(Q) and P(Q) characteristics of over 60 different partial flow centrifugal pumps. This has made it possible to go beyond individual habits and traditions, while preserving anonymity. The study has pointed up general trends and areas of convergence of points portraying pumps with satisfactory H(Q) characteristics, which can only be departed from with extreme caution. As partial flow operation is associated with the more-or-less sudden appearance of critical flow, it was logical to extend the statistical study to the various relative values of this critical flow. This has been the authors' aim, while proposing an approximate method based on the interpretation of graphs representing P(Q) characteristics. (Author's abstract)
W84-05024

HYDRAULIC INVESTIGATION OF A PROPOSED DIVERSION OF THE RIVER CLYDE,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. F. Riddell, and J. Ellis.
Journal of the Institution of Water Engineers and Scientists, Vol. 37, No. 1, p 28-40, February, 1983. 7 Fig, 3 Tab, 2 Ref.

Descriptors: *River Clyde, *Hydraulic design, *Diversions, *Highways, Channels, Construction, Diversion channels, Model studies, Planning, Flood control, Culverts, Environmental effects.

The range of possible options available to satisfy economic, hydraulic, and environmental constraints affecting the proposal for the Hamilton Road Route to make a double crossing of a meander of the River Clyde was considered. A numerical model study was undertaken to examine the feasibility of the option chosen. The arrangement of restricted flow culverts at the road crossings together with a diversion channel which would come into use only during times of flood was found to provide a solution which resulted in no increase in the probability of upstream flooding, and the maintenance of environmentally acceptable conditions at times of low flow. The hydraulic constraints of maintaining some flow in the by-passed channel and causing an increase in upstream water levels produced a complicated problem of analysis which was tackled by means of a numerical model. After calibration from existing flow and level data, the model allowed a rapid assessment of the effects of varying the geometry of both the diversion channel and the culverts. It is possible to provide a diversion channel/culvert configuration which will maintain low flows, and an element of flood flushing, in the existing channel while not causing any increase in upstream water levels during times of flood. The diversion option was hydrologically feasible, but it was later decided that the cost advantages were not as significant as first thought. The decision has been made to construct two conventional bridges at Cuningar, with the numerical model now being employed to study the effect on water levels of different arrangements of bridge piers and temporary works. (Baker-IVI)
W84-05050

FLOODFLOW FORECASTING DURING DAM CONSTUCTION,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
International Water Power and Dam Construction, Vol. 36, No. 5, p 15-17, May, 1984. 2 Fig, 4 Tab, 6 Ref.

Descriptors: *Flood forecasting, *Dam construction, *Pournari Dam, *Greece, Construction, Dams, Flood control, Prediction.

A short-term real time floodflow forecasting method is presented for the Pournari dam site in Greece during the construction of the diversion works. The floodflows are accurately forecast at a flow measuring station in the neighborhood of the dam site by the use of water level and rainfall information from key stations located upstream. The time of the flood arrival is also estimated. The method is simple to use and accurate. It does not need a computer and gives sufficiently long forecasting times for adequate preparation at the site. It can be applied cheaply and successfully to short term floodflow forecasting in real time. (Baker-IVI)
W84-05097

TWO-D FLOW WITH SEDIMENT BY CHARACTERISTICS METHOD,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 2A.
W84-05148

CONTROL OF WATER HAMMER IN WATER SUPPLY SYSTEMS (BEHERRSCHUNG VON DRUCKSTOBEN BEI WASSERVERSORGUNGSSYSTEMEN),
Sulzer Bros. Ltd., Winterthur (Switzerland).
H. Waller.
Wasserwirtschaft, Vol. 73, No. 4, p 113-119, April, 1983. 10 Fig, 2 Tab, 14 Ref.

Descriptors: *Water hammer, *Water conveyance, Flow characteristics, Hydraulic machinery, Pumps, Pump speed, Hydraulic valves, Drive mechanisms, Computer programs.

Water hammer investigations are particularly important for the water supply systems of complicated installations. This article considers the instationary flow conditions that occur during start-up,

shutdown and changeover of the pump, change of valve position and pump speed, or when the drive mechanism fails. Systems that operate with high velocity and low pressure are particularly endangered. Unacceptable underpressure should also be avoided to ensure that the column of water remains intact. Installations constituting a danger risk are equipped with flywheels and expansion chambers. These safety elements can be determined approximately or with the aid of a computer program. The article concludes with a calculation example. (Murphy-IVI)
W84-05238

HYDRAULIC AND OPERATIONAL ASPECTS FOR THE ENERGY RECOVERY CONCEPT APPLIED AT THE WATER RESERVOIR SCHONBUHL OF THE LANDESWASSERVERSORGUNG STUTTGART (HYDRAULISCHE UND BETRIEBLICHE ASPEKTE DER ENERGIERUCKGEWINNUNGS - ANLAGE SCHONBUHL DES ZWECKVERBANDES LANDESWASSERVERSORGUNG),
Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
D. Flinspach, J. Giesecke, and H.-B. Horlacher.
Wasserwirtschaft, Vol. 73, No. 7/8, p 226-230, 1983. 6 Fig, 1 Tab, 5 Ref.

Descriptors: *Energy recovery, *Schonbuhl reservoir, *West Germany, Francis turbines, Hydroelectric power, Pipelines, Head, Hydrodynamics, Transient flow, Water hammer.

In connection with the new large water reservoir Schonbuhl built by the water supply authority 'Zweckverband Landeswasserversorgung', a fourth energy recovery facility was integrated in the existing system composed of three long distance pipelines. A Francis turbine of 955 kW capacity, drawing off 55 m head between both Thomashardt and Schonbuhl reservoirs, is used for this purpose. This concept of energy recovery allows a return of about 20% of pumping energy; the latter being used subsequently for the operation of the above-mentioned long distance pipelines. The hydrodynamic effects of transient flow resulting from turbine operation have been determined by measurements and detailed waterhammer calculation. (Author's abstract)
W84-05247

8C. Hydraulic Machinery

INTEGRATED DEVELOPMENT OF A LARGE RIVER: THE RHONE; B. DEVELOPMENT OF ELECTRO-MECHANICAL EQUIPMENTS (L'AMENAGEMENT INTEGRE D'UN GRAND FLEUVE: LE RHONE; B. EVOLUTION DES EQUIPEMENTS ELECTROMECANIQUES),
Compagnie Nationale du Rhone, Lyon (France).
P. Cazenave.
La Houille Blanche, Vol. 5/6, p 427-432, 1982. 6 Ref.

Descriptors: *Rhone River, *France, *Water resources development, Valves, Gates, Dams, Turbines, Automation, Locks, Hydroelectric plants, Electrical equipment, Mechanical equipment.

It took half a century to develop the Rhone River between Genissiat and Loyettes, France. Low heads have been harnessed. The development had to comply with operating constraints related to energy generation and navigation, and allow for substantial variation in flows and head. Technological improvements and operating experience have led to major changes in the following; flow and head; safety valves; discharge facilities; bulb generating sets; automation; locks; and dams. The large locks (12 x 195 m) on the Rhone have led to the development to increasingly reliable units, necessitated by the fact that each lock is in permanent service. Twenty-one main dams have been built, including 20 mobile dams on the rivers. Major progress has been made in construction, especially gate construction. (Moore-IVI)
W84-05020

DESIGN AND CONSTRUCTION OF LARGE TURBINES. THE FRANCIS TURBINES OF THE TUCURUI STATION (BRAZIL) (CONCEPTION ET CONSTRUCTION DES TURBOMACHINES DE GRANDES DIMENSIONS, LES TURBINES FRANCIS DE LA CENTRALE DE TUCURUI (BRESIL),
Neyrpic, Grenoble (France). Bureau d'Etudes Turbines.
A. Sauron, and G. Caillot.
La Houille Blanche, Vol. 5/6, p 473-486, 1982. 3 Fig, 1 Tab.

Descriptors: *Turbines, *Tucurui Hydroelectric Station, *Brazil, Francis turbines, Design, Construction, Hydraulic design, Computers.

Increasing the unit power of hydroelectric turbines while improving the use ratios of sets is governed by the need to make developments profitable. The problems met and their solutions regarding design, calculation and the construction of large turbines have been reviewed using the example of the Tucurui turbines currently being assembled. The Tucurui hydroelectric project is located on the river Tocantin in the northern part of Brazil, about 300 km from Belem. Topics discussed include: hydraulic design; mechanical design; study and construction of the main parts; and load support bearing exceeding 2000 tons. New prospects have been opened up by the use of computer aided design and the development of manufacturing facilities. (Moore-IVI)
W84-05022

UNCERTAINTIES TO BE TAKEN INTO ACCOUNT ON H(Q) AND P(Q) CURVES OF PARTIAL FLOW PUMPS AND PUMP TURBINES (INCERTITUDES A PRENDRE EN COMPTE SUR LES COURBES H(Q) ET P(Q) A DEBIT PARTIEL DES POMPES ET DE POMPES-TURBINES),
Societe Franco-Americaine de Constructions Atomiques, Courbevoie (France).
J. P. Clement, J. M. Deplanque, H. Quesnon, J. F. Lapray, and R. Philibert.
La Houille Blanche, Vol. 2/3, p 121-130, 1982. 10 Fig, 1 Ref.

Descriptors: *Pump turbines, *Partial flow pumps, Hydraulic equipment, Pumps, Model studies, Nuclear powerplants.

The manufacturers and users of pumps and some pump turbines are increasingly confronted with the problem of drawing up characteristic curves respecting contractual values which can range from no flow to overflow and often allow partial flow operation to be performed satisfactorily. In practice: on the one hand, there are differences between forecast curves drawn up on the basis of tests using a scale model and the curves recorded on an industrial machine; on the other hand, there are often large differences between the characteristic curves of machines which are known to be identical. The paper attempts to illustrate the importance and origin of these differences and their physical effects on the respect of requirements. The uncertainties due to the transposition of curves of the model and the influence of small geometrical differences in construction are underlined. It also attempts to ascertain the reasons underlying operating requirements and constraints recorded on the characteristics curves of pumps used in PWR nuclear power stations. (Author's abstract)
W84-05025

INFLUENCE OF THE DOWNSTREAM GEOMETRICAL LAYOUT OF THE IMPELLER ON THE CHARACTERISTICS OF PARTIAL FLOW PUMPS (INFLUENCE DE LA GEOMETRIE DE L'ENVIRONNEMENT AVAL DE LA ROUE SUR LES CARACTERISTIQUES DES POMPES A DEBIT PARTIEL),
Ecole Nationale Superieure des Arts et Metiers, Lille (France). Lab. de Mecanique.
G. Caignaert.
La Houille Blanche, Vol. 2/3, p 131-138, 1982. 13 Fig, 19 Ref.

Descriptors: *Centrifugal pumps, *Impellers, Geometry, Partial flow pumps, Vaned diffusors, Volutes, Pumps.

Geometrical parameters of vaned diffusors and volutes influence partial flow characteristics of centrifugal pumps. Modifications of the casing downstream of the impeller concern many geometrical parametes, and it is not easy to characterize the results: only trends emerge. These trends vary according to the type of pump (specific speed influence) and to the impeller geometry; a general trend seems to be much more difficult to obtain for pumps operating at low specific speed. Some changes made in the volute have an influence on the partial flow characteristics of single-volute pumps. The volute tongue appears to be most important, especially the relative radial gap and the tongue radius: Head coefficients increase and power coefficients tend to decrease when these parameters increase. The case of vaned diffuser pumps is then examined. Modification of vaned-diffusor inlets, including the relative radial gap, the blade inlet radius, the blade inlet angle, the diffusor throat area, the diffusor's axial position in relation to the impeller and gaps between impeller and casing were also investigated. (Moore-IVI)
W84-05026

CRITICAL FLOW ENGENDERING APPEARANCE OF RECIRCULATION AT CENTRIFUGAL PUMP IMPELLER INLET: DETERMINANT PHENOMENA, DETECTION METHODS, FORECASTING CRITERIA (DEBIT CRITIQUE D'APPARITION DE LA RECIRCULATION A L'ENTREE DES ROUES DE POMPES CENTRIFUGES: PHENOMENES DETERMINANTS, METHODES DE DETECTION, CRITERES DE PREVISION),
Worthington S.p.A, Milan (Italy).
B. Schiavello.
La Houille Blanche, Vol. 2/3, p 139-158, 1982. 13 Fig, 2 Tab, 24 Ref.

Descriptors: *Centrifugal pumps, *Critical flow, Model studies, Recirculation, Impellers, Volutes, Pumps.

The relationship between the 'peak' of the curve at the beginning of cavitation and the critical flow producing the appearance of recirculation and prerotation at impeller inlet is studied. A physical analysis of the phenomenon of the boundary layer separation on the blade section side in the centrifugal pump impeller shows that there is no direct influence of centrifugal forces, a limited direct influence of the Coriolis forces, a critical influence of the aerodynamic forces, and an important influence of the tridimensional and viscous phenomena. The impeller design appeared more crucial than the volute design. The detection of the critical capacity is important in order to determine the reliable operating range of a pump. Direct methods for testing critical capacity are more suitable for research on models because they are accurate and complete, but also time consuming. The indirect methods show an acceptable scattering. The adoption of several indirect methods reduces the degree of uncertainty and seems to be a reliable procedure for field detection of the critical capacity of full scale pumps. Advance calculation of critical flow using simple mono-dimensional models, adjusted using different factors portraying tri-dimensional effects and losses, requires a careful forecast of the relative flow at impeller outlet in partial flow operating conditions. (Moore-IVI)
W84-05027

OPERATION IN PARALLEL OF PUMPS WITH HUNCHBACK CURVATURE (FONCTIONNEMENT EN PARALLELE DE POMPES A COURBES BOSSUES),
Conservatoire National des Arts et Metiers, Paris (France).
M. Sedille, M. Frelin, and M. Pluviose.
La Houille Blanche, Vol. 2/3, p 159-166, 1982. 13 Fig.

Descriptors: *Pumps, *Parallel operation, Pump inlets, Model studies, Mathematical models, Hydraulic models.

Parallel operation of pumps with 'hunchback curvature' leads to either stable or unstable operating conditions, depending on the system they supply and its inlet variations. Stable operating conditions are obtained when the two pumps operate in the stable part of their characteristics, and in certain cases when one operates in the stable part and the other in reverse flow. Their study requires modeling the system as a whole, and writing equations of movement which take inertia and capacity into account. The study of a special case which arose (pumps with slightly different characteristics) has shown that the schematic approach followed was inadequate and that the inertia conditions of all sections, including pump sections, had to be taken into account to portray observed phenomena. When pressure values are low, the capacity of pipes can be neglected, considering only mass movements. Beyond that, wave propagations would have to be taken into account. (Moore-IVI)
W84-05028

HYDRODYNAMIC VISUALIZATION OF FLOW USING A SCALE-MODEL OF AN AXIAL FLOW TURBOMACHINE (VISUALISATION HYDRODYNAMIQUE DE L'ECOULEMENT DANS UNE MAQUETTE DE TURBOMACHINE AXIALE),
Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux (France).
H. Werle.
La Houille Blanche, Vol. 2/3, p 175-184, 1982. 7 Fig, 14 Ref.

Descriptors: *Model studies, *Turbines, *Hydrodynamics, Hydraulic models, Simulation, Rotating stall, Eddies.

The physical study of non-stationary flow in a scale-model fitted with an isolated mobile runner or in the presence of a rectifer was performed through visual examination carried out in a vertical hydraulic vessel. The runner is fitted with 20 cylindrical vanes (circumference = 50 mm) and is placed in a cylindrical channel (radius of casing = 146 mm). As the flow velocity and the speed of rotation of the runner are controlled and regulated independently, all operating conditions can be simulated. Terminal stage flow is highly sensitive to the load variations necessitated by its environment. A separated flow rotation en bloc with the mobile blades occurs at the downstream section of the blade when the volume flow is reduced to 25% below its rated value. The stall then increases and forces the flow to the central part and the periphery up to the point at which a second toric vortex is formed upstream and at the tip of the blade. This eddy rotates at virtually the same speed as the mobile blades. At zero flow, the two eddies rotating in opposite directions invade the channel and produce losses due to ventilation, in which the centrifugal effect is dominant. (Moore-IVI)
W84-05030

ANALYSIS OF INDUSTRIAL TESTING OF TURBINE PUMPS OUTSIDE NORMAL AND DURING TRANSIENT OPERATING CONDITIONS (ANALYSE DES ESSAIS INDUSTRIELS DES TURBINES-POMPES HORS DES ZONES DE FONCTIONNEMENT NORMAL ET LORS DES TRANSITOIRES),
Neyrpic, Grenoble (France).
S. Casacci, and P. Jarriand.
La Houille Blanche, Vol. 2/3, p 185-196, 1982. 17 Fig.

Descriptors: *Pump turbines, *Transient operating conditions, Turbines, Rotation, Wear, Stress, Start-up, Shutdown, Model studies, Hydraulic models.

When the Cheylas station, equipped with two 250 MW turbine pumps under 250 m head, was put in service, a very large testing program was undertaken to analyse the behavior of these machines in main normal transient operating conditions. The operation of turbine pumps requires daily start ups and shutdowns, with or without a change in the direction of rotation. Their frequent operation outside the range of optimum use should not engender abnormal wear of equipment. It is thus important to know the stresses to which these reversible machines are subjected during transient operating conditions, including turbine or pump trip when the gate operating mechanism is blocked in the open position. The present paper analyses the results of tests performed on pump start up, turbine and pump trip with the gate operating mechanism open, on-load cuts and operating in compensator mode. The comparison of the results of industrial tests with those obtained on scale-models shows that the stresses applied to the main parts of the machine can be estimated with an adequate degree of accuracy. This finding allows the components of these machines to be manufactured to a size guaranteeing operating conditions over time similar to those of the best conventional turbines. (Author's abstract)
W84-05031

INFLUENCE OF CAVITATION ON AVERAGE AND INSTANTANEOUS CHARACTERISTICS OF TURBINES AND PUMP TURBINES (INFLUENCE DE LA CAVITATION SUR LES CARACTERISTIQUES MOYENNES ET INSTANTANEES DES TURBINES ET DES POMPES-TURBINES),
Hydroart S.p.A., Milan (Italy).
G. Borciani.
La Houille Blanche, Vol. 2/3, p 197-208, 1982. 11 Fig, 8 Ref.

Descriptors: *Cavitation, *Francis turbines, *Pump turbines, *Turbines, Runaway speed, Model studies, Hydraulic models.

The influence of cavitation on the average characteristics of a Francis turbine or Francis-type pump turbine is studied for abnormal operating conditions, in the following areas: instability area during operation as a pump; zero flow pump mode; area of reduced flow as a turbine; runaway speed; turbine-brake; and reverse pump quadrant. Based on laboratory measurements on a model, the critical sigma values found in the five areas mentioned are higher than those of standard sigma values for the areas of the machine under normal operating conditions. Particular importance is place on two observed cases of hydraulic instability: a pump-turbine operating as a partial flow pump, and a turbine of average specific speed. Instability is a function of the cavitation coefficient which determines the shift form one hydraulic behavior to another at the runner outlet. The influence of cavitation on the instantaneous characteristics is examined in a turbine at full load, at a low rate of flow and at runaway speed. The decrease in cavitation coefficient causes an increase of the fluctuations both at partial flow and at runaway seed for some of the magnitudes examined. When designing a hydraulic machine, the laboratory tests on the model should be extended to a wide range of sigma values covering the values projected for the prototype. (Moore-IVI)
W84-05032

EXPERIMENTAL ANALYSIS OF THE HYDRAULIC STABILITY OF THE PARTIAL LOAD FRANCIS TURBINE (ANALYSE EXPERIMENTALE DE LA STABILITE HYDRAULIQUE DE LA TURBINE FRANCIS A CHARGE PARTIELLE),
Ecole Polytechnique Federale de Lausanne (Switzerland).
P. Henry, M. Wegner, and J. E. Graeser.
La Houille Blanche, Vol. 2/3, p 209-218, 1982. 11 Fig, 21 Ref.

Descriptors: *Frances turbines, *Hydraulic stability, Turbines, Model studies, Hydraulic models, Torque, Pressure fluctuations, Cavitation, Head.

An attempt is made to clarify the relationships between hydraulic stability and pressure fluctuations, based upon the knowledge that this stability is expressed in terms of the fluctuation of the motor torque of the turbine shaft. The role of the different frequencies produced by the flow is studied in particular. Frequencies, amplitudes and phases measured on the scale-model are systematically analysed. Two main parameters govern these model tests: the degree of cavitation with a constant operating head; and the operating head keeping constant either the cavitation number or the dimension of the cavitating dead water core. At the dominant frequency, pressure fluctuations in the draft tube can increase without magnifying torque fluctuation or pressure fluctuation in the volute in the same proportion. By contrast, when there is a marked increase of the amplitude at the first harmonic of the pressure fluctuation in the draft tube, the motor torque fluctuations follow a similar behavior. The head has no relevant effect, especially the lowest, which does not induce a lower value of relative fluctuations. Observed dimensions of the cavitating dead water core are not sufficiently developed to draw a firm conclusion as to the effect of the operating head. (Moore-IVI)
W84-05033

CHARACTERISTICS OF AXIAL THRUST (CARACTERISTIQUES DES POUSSEES AXIALES),
Ecole Polytechnique Federale de Lausanne (Switzerland).
P. Henry, V. Zanetti, and M. Wegner.
La Houille Blanche, Vol. 2/3, p 227-236, 1982. 15 Fig.

Descriptors: *Axial thrust, *Hydraulic machinery, Turbines, Pump turbines, Francis turbines, Load, Specific speed, Mathematical studies.

It is important to have specific knowledge of axial thrust in hydraulic machinery, especially for large turbines and pump turbines, for the purpose of calculating thrusts. Internal forces are induced by both pressure and momentum effects. Nondimensional parameters corresponding to the internal and external components are calculated and plotted against specific speed for the optimum operating range. The theoretical forecast of thrust is not too difficult in the neighborhood or optimum efficiency of machines. An example is given of the relationship between static pressures, discharge and axial thrust for a turbine rotating at average specific speed. High specific speeds are more sensitive to flow variations than low specific speeds. The calculation of internal thrust illustrated by a standardized Francis turbine runner channel. External thrust is then measured for a simplified runner layout. As one moves away from optimum efficiency, the calculation becomes more difficult. Measurements using a scale-method alone provide results which must be used with great caution because of the problems of similarity. These problems become particularly acute when the specific speed decreases. The calculation of axial thrust at optimum load may be considered safe, but the same calculation in the partial load range remains inaccurate due to three-dimensional and non-stationary effects. (Moore-IVI)
W84-05034

RADIAL THRUST IN HYDRAULIC MACHINES: LABORATORY TESTING (LA POUSSEE RADIALE DANS LES MACHINES HYDRAULIQUES: EXPERIENCES DE LABORATOIRE),
Hydroart S.p.A., Milan (Italy).
V. Zanetti.
La Houille Blanche, Vol. 2/3, p 237-246, 1982. 15 Fig.

Descriptors: *Hydraulic machinery, *Radial thrust, *Francis turbines, Turbines, Thrust, Runaway, Hydroelectric plants, Rope frequency, Specific speed, Pump turbines.

The radial thrust exerted by the flow on the runner plays an important role among the loads acting on a hydraulic machine at the different operating conditions. The fixed thrust is due to dyssymmetries in the stationary parts. It has the effect of bending the shaft line and loading the guide bearings. A second type of thrust is the dynamic thrust which causes vibrations and has more importance in machine design, especially for machines for hydroelectric plants. The thrust rotating at the rope frequency,

characteristic of the operation of a Francis turbine at a partial load or runaway conditions, may cause sliding of the rotating part on the stationary part at the labyrinths. This must be taken into account when calculating fatigue strength. Radial thrust rotating at the rope frequency is directly associated with the pressure pulse below the runner and increases with the specific speed of the unit. A similar phenomenon occurs in runaway operation: the thrust attains its maximum value in high specific speed Francis turbines. Random thrust occurs at different operating conditions; in pump turbines reaching its peak values at runaway, in the braking mode and in the pump mode at strongly reduced flows. (Moore-VI)
W84-05035

VIBRATIONS OF GUIDE VANES OF TURBOMACHINERY IN RUNAWAY OPERATION (VIBRATIONS DES DIRECTRICES DES TURBOMACHINES A L'EMBALLEMENT),
Neyrpic, Grenoble (France).
P. Boussuges, H. Amblard, and C. Lathuile.
La Houille Blanche, Vol. 2/3, p 247-256, 1982. 10 Fig.

Descriptors: *Guide vanes, *Turbines, *Runaway, *Vibration, Hydraulic machinery, Model studies, Pressure pulses, Specific speed, Torque.

Stresses suffered by the mobile guide vanes of turbomachinery under runaway conditions are investigated, based on scale-model and industrial machine testing. After analyzing pressure pulses in the air-gap between the runner and the distributor, induced by the runner, for machines operating at different specific speeds, torque fluctuation values relating to guide vanes are examined. An attempt is made to draw up a general law providing an order of magnitude for these values. An attempt is also made to give a finer analysis of the findings to identify the parameters influencing the pheomenon: the shape of guide vanes, the air-gap between the runner and the distributor, and the geometry of the runner. While it has been possible to identify the air-gap, the influence of the various parameters associated with the runner is too complex to allow specific laws to be stipulated presently. A synthesis of approximate overall laws is presented. (Author's abstract)
W84-05036

QUASI THREE-DIMENSIONAL FLOWS IN HYDRAULIC TURBOMACHINES (MODELISATION QUASI-TRIDIMENSIONNELLE DES ECOULEMENTS DANS LES TURBOMACHINES HYDRAULIQUES),
Neyrpic, Grenoble (France).
L. R. Eremeef, and R. Philibert.
La Houille Blanche, Vol. 7/8, p 543-552, 1982. 8 Fig, 9 Ref.

Descriptors: Mathematical models, *Hydraulic machinery, *Turbines, Rotors, Meridional flow, Blade-to-blade flow, Flow.

The three-dimensional flow of a perfect, incompressible fluid through the rotor of a turbomachine is studied with a method using two-dimensional flows: meridional flow, and blade-to-blade flow. The mathematical model used exploits the theory of quasi-three-dimensional flows known under the name of the S1-S2 surfaces model. The method consists of coupling a calculation of meridian flow with a 'blade-to-blade' calculation until the solutions come together. The two flow programs use to advantage the same types of algorithm, which permit transformation of the nonlinear Poisson-type equations into integral Fredholm equations of the second kind. Good results are obtained with this flow model. (Moore-IVI)
W84-05037

THEORETICAL-EXPERIMENTAL ANALYSIS OF REAL FLOWS IN ASSORADIAL PUMPS (ANALYSE THEORIQUE-EXPERIMENTALE DE L'ECOULEMENT REEL DANS LES POMPES ASSORADIALES),
Florence Univ. (Italy). Ist. di Energetica.
E. Carnevale, S. Giusti, and G. Angelo.
La Houille Blanche, Vol. 7/8, p 553-557, 1982. 8 Fig, 3 Ref.

Descriptors: *Mathematical models, *Pumps, *Flow, Centrifugal pumps, Mixed-flow pumps, Impellers, Entropy, Blades, Runners.

A numerical model is developed for non-isoentropic through-flow calculation in centrifugal and mixed-flow pump impellers. The calculation is developed on an S2 type surface (using WU's theory) in the presence of a field of frictional forces. The flow is assumed to take place in the presence of a dissipative force field locally opposite to the relative velocity vector and tangent to the stream line. Combining the basic equations of continuity, entropy production, energy and motion, defining the local geometry of the stream surface S2 and the stream function psi, it is possible to derive a final flow equation. The stream surface equation is obtained starting form the blade geometry and considering its distortion due to the slip effect. In the final flow equation, an entropy gradient appears that can be correlated with the values for total pressure at the runner input and output. The numerical model is applied to analysis of the flow in an assoradial runner for three different operating conditions; the design conditions and two off-design working points. (Moore-IVI)
W84-05038

MODEL OF THE FLOW IN FRONTOSPIRAL CASING (MODELE D'ECOULEMENT DANS LES BACHES FRONTO-SPIRALES),
Neyrpic, Grenoble (France).
J. Corniglion, P. Vinh, and M. Couston.
La Houille Blanche, Vol. 7/8, p 571-578, 1982. 9 Fig, 6 Ref.

Descriptors: *Hydraulic design, *Kaplan turbines, Hydraulic models, Flow, Turbines, Hydraulic machinery, Turbulence, Blades.

The problem of the hydraulic design of the feed tank for a low-head Kaplan turbine has been solved by making numerous modifications to the layouts after experimental trials. The object of this study is to design a theoretical model of the flow that will permit a proper supply to the turbomachine while keeping velocities and flow rates homogeneous in the peripheral sense in order to obtain maximum efficiency for the installation. The present approach makes it possible to design the tank, fitted with guide vanes, in a way that will provide this condition of homogeneity. The procedure is to solve a quasi-three-dimensional field problem by a semi-inverse method from calculation of the distribution of the associated turbulence that each guide blade must generate; the blade shape is deduced from this distribution. Numerical results applied to an industrial configuration are presented. (Author's abstract)
W84-05039

FLOW FIELD ANALYSIS IN A KAPLAN TURBINE: COMPARISON BETWEEN THEORETICAL CALCULATIONS, VELOCITY MEASUREMENTS AND CAVITATION OBSERVATIONS (ECOULEMENT DANS UNE TURBINE KAPLAN: COMPARAISON ENTRE CALCUL THEORIQUE, MESURES DE VITESSE ET OBSERVATIONS DE CAVITATION),
Hydroart S.p.A., Milan (Italy).
O. Ceravola, M. Ubaldi, P. Zunino, and A. Satta.
La Houille Blanche, Vol. 7/8, p 579-587, 1982. 12 Fig, 7 Ref.

Descriptors: *Kaplan turbines, *Cavitation, *Flow field, Flow velocity, Computers, Mathematical equations, Blades, Runners.

Experimental and theoretical results of the flow field analysis in a medium specific speed Kaplan turbine model are presented. The experimental analysis consists of velocity and total pressure measurements taken with bidirectional probes in three sections upstream and one downstream of the runner, and observation and photos of the cavitation zones on the blade surfaces and in the blade channels for different values of the the cavitaiton coefficient. The quasi-three dimensional analysis of the flow field was carried out using a computer program based on the method of fixed projection lines. A program based on the method of integral equations was used for the blade-to-blade calculation. An exact prediction of the extension of the cavitating regions cannot be obtained because the method does not take into account the effect of the vapor bubbles on the pressure distribution, but the calculations generally are in good agreement with the cavitation configurations. (Moore-IVI)
W84-05040

EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE BEHAVIOUR OF A REVERSIBLE PUMP-TURBINE RUNNER AT AND OFF DESIGN CONDITIONS (RECHERCHE EXPERIMENTALE ET NUMERIQUE SUR LE COMPORTEMENT D'UNE ROUE REVERSIBLE AU POINT DE TRACE ET HORS DU POINT DE TRACE),
Padua Univ. (Italy).
G. Ventrone, A. Mirandola, and G. Navarro.
La Houille Blanche, Vol. 7/8, p 607-613, 1982. 11 Fig, 7 Ref.

Descriptors: *Pump turbines, *Hydraulic machinery, *Turbines, Model studies, Mathematical equations, Runners, Vanes, Impellers, Flow velocity.

The behavior in pumping mode of a reversible runner was analysed with and without diffusion vanes. The runner tip clearance has been traversed in pump operation in order to examine the distortion of the flow induced by the stationary system. The average values of flow angle, velocity, and total pressure agree with theoretical estimates only at the matching point of runner and diffuser. At lower or higher rates the average value of the meridional component of the absolute velocity differed considerable from actual through-flow. The runner input head obtained from the averaged values of the tangental component of the velocity, which was expected to be greater than the total head rise through the runner, appeared to be smaller than the latter at flows below the design rate and greater at higher flows. The discrepancies may be due to the interaction of runner and stationary vanes, which distort the flowlines in the clearance annulus. The stationary vanes were removed from the diffuser channel so as to obtain an unobstructed annulus where free flow conditions would be set up, comparable to those existing outside an isolated runner. Flow measurement showed better consistency with theoretical estimates. The ratio of slip velocity to runner tangential velocity did not change appreciably with the rate of flow. Known numerical solutions of the equation of motion may yield satisfactory results provided no external action is exeerted on the runner flow other than the pressure forces exchanged by the runner itself. For pump runners with volute or vaned diffuser casings, the boundary conditions at the impeller exit should be defined by an equation expressing the distorting effects of the stationary system on the flow. (Moore-IVI)
W84-05041

DIPHASIC FLOW DOWNSTREAM OF CIRCULATION-WATER CONDENSER DURING PRIMING (ECOULEMENT DIPHASIQUE A L'AVAL D'UN CONDENSEUR DE CIRCUIT DE CIRCULATION EN COURS D'AMORCAGE),
B. Ibler, M. Sabaton, and R. Canavelis.
La Houille Blanche, Vol. 7/8, p 623-632, 1982. 15 fig, 1 Ref.

Descriptors: *Priming, *Condensers, *Diphasic flow, *Nuclear powerplants, Water cooling, Cooling, Pipes, Cost analysis.

The experimental study presented here describes the experiments for visualizing diphasic flow carried out on a 1/10 model of a circulation-water condenser for a 1,300-MW nuclear power unit. The essential object of the experiments was to validate the layout for the tubing proposed by the Design Office, from the point of view of its incidence on the stability of the flows and the mechanical solidity of the structures during the relatively anarchical phase of automatic priming of the con-

denser. The observations made have rendered it possible first to analyze the pattern of flows in greater detail and secondly to conclude that a simplified and cheaper layout of pipes is acceptable without great risk. (Author's abstract)
W84-05042

SUPERCAVITATING THREE-DIMENSIONAL FLOWS. NUMERICAL TREATMENT IN EXACT THEORY. EXPERIMENTS IN A HYDRODYNAMIC TUNNEL. CRITICAL ANALYSIS OF THE RESULTS (ECOULEMENTS TRIDIMENSIONNELS SUPERCAVITANTS: TRAITEMENT NUMERIQUE EN THEORIE EXACTE, EXPERIMENTATION EN TUNNEL HYDRODYNAMIQUE, ANALYSE CRITIQUE DES RESULTATS),
A. R. Laali, and C. Pellone.
La Houille Blanche, Vol. 7/8, p 641-653, 1982. 18 Fig, 2 Tab, 9 Ref.

Descriptors: *Hydrodynamic design, *Cavitation, *Hydraulic machinery, Hydrofoils, Mathematical studies.

The very rapid flows around load-bearing wings (hydrofoils) are of interest because of their use in high-speed marine vehicles, increased use potential for machine parts and the operation of hydraulic components in velocity ranges higher than nominal. An essential difficulty for the correct use of this type of wing is the determination of the free field of cavitation. A series of tests was carried out on a wing of fixed profile whose sweep-back was varied by rotation around an axis at the root, and whose aspect ratio was varied by successive cutting back. The tests were carried out in a hydrodynamic tunnel. Theoretical and experimental results were subjected to critical analysis of the influence of the principal geometric parameters and the area of non-cavitation. When the aspect ratio of a ventilated-base wing is reduced, a study of the slope of the curve, the coefficient of lift in terms of angle of attack, and of the spread of non-cavitation reveals a significant increase in the spread on non-cavitation. This illustrates the advantage of using wings of very low aspect ratio in order to increase the possible incidence deflections of the wing. For swept-back wings, cavitation on the upper surface appears at about 2/3 of the span; on the under surface, cavitation appears first at the wing root. There may be an advantage in using a twisted wing, with a smaller angle for the end sections of the wing than those for the root. (Moore-IVI)
W84-05043

FINITE-ELEMENT CALCULATION OF BLADE-TO-BLADE FLOW IN PUMPS (CALCUL AUX ELEMENTS FINIS DE L'ECOULEMENT AUBE A AUBE DANS LES POMPES),
Florence Univ. (Italy). Ist. di Energetica.
F. Martelli, and G. Manfrida.
La Houille Blanche, Vol. 7/8, p 665-671, 1982. 12 Fig, 1 Tab, 6 Ref.

Descriptors: *Hydraulic machinery, *Turbines, Mathematical studies, Simulation, Flow velocity, Impellers.

Inviscid flow numerical calculations offer a valid tool for the analysis and design of turbomachines. Usually, the coupling of two sets (S1 and S2) of two-dimensional calculation is used to obtain a quasi-three-dimensional simulation of the flow in the turbomachine. The S1 surface calculation is particularly important as it gives important information on the velocity and pressure field inside the bladed channel, and it can lead to a satisfactory calculation of the outlet angle. The proposed numerical analysis is based on the solution of the flow equations on an axisymmetric S1 surface. The analysis is performed directly in the m (meridian abscissa) and theta (angular abscissa) coordinates, using three-node triangular finite elements, after quasi-variational reformulation of the problem. The input is simplified by a generalized use of spline extrapolation techniques, which allow satisfactory discretizations to be obtained starting with a limited set of impeller geometric data. Results of the calculations are presented for two centrifugal runners. (Moore-IVI)
W84-05044

LASER ALIGNMENT TECHNIQUES AT THE WIMBLEBALL RESERVOIR,
D. Wallis.
International Water Power Dam and Construction, Vol. 36, No. 5, p 33-34, May, 1984. 6 Fig.

Descriptors: *Deflection, *Lasers, *Wimbleball Dam, *England, Zone plate alignment, Measuring instruments, Dams.

Zone plate alignment techniques for measuring the deflection of large and small structures have been available for at least ten years. A recent example is the Wimbleball reservoir in Somerset, England, where a laser-based zone plate system, based on an optical level principle, has been installed. Such a system must be capable of detecting deflections with accuracies on the order of 1 mm. The laser is used merely to define a point on the optical reference axis by passing through a reference hole located at one end of the dam. It illuminates a zone plate made up of concentric metal rings, which is equivalent to a long focus lens focussing the hole image on to the measuring target. Its three point system eliminates errors caused by laser misalignment. Misreadings can result, however, from atmospheric turbulence which will affect the image. (Baker-IVI)
W84-05100

HYDROTURBINE VENTING FOR DISCHARGE OXYGENATION,
Tennessee Valley Authority, Norris.
E. D. Harshbarger, S. Vigander, and L. M. Beard.
Journal of Hydraulic Engineering, Vol. 110, No. 5, p 604-613, May, 1984. 11 Fig, 5 Ref.

Descriptors: *Oxygenation, *Turbines, *Hydroturbine venting, Hydroelectric plants, Baffles, Dissolved oxygen.

In the southeastern U.S., hydroturbine discharges from multipurpose storage reservoirs often contain less than the desired levels of dissolved oxygen (DO). These low DO levels usually occur during the summer and autumn and are typically caused by thermal stratification of the reservoir. One method for increasing the DO concentration in hydroturbine discharges is turbine venting, whereby air is aspirated into the turbine draft tube, below atmospheric pressure. Tests were conducted on two existing hydroturbines to evaluate turbine venting as a means of oxygenating discharged water. The hydroturbines were of the vertical Francis type, with a rated capacity of 49 MW at 50 m net head. Additions of baffles to the turbine runner hub and to the draft tube wall were made to generate local suction for aspirating air. The effects of these baffles were evaluated in terms of flow rate of induced air, dissolved oxygen uptake and the effect on unit efficiency and output. Baffles can be used to increase aspirated air and thus dissolved oxygen uptake, but that there is a related loss in turbine efficiency and capacity. (Moore-IVI)
W84-05147

CONTROL OF WATER HAMMER IN WATER SUPPLY SYSTEMS (BEHERRSCHUNG VON DRUCKSTOBEN BEI WASSERVERSORGUNGSSYSTEMEN),
Sulzer Bros. Ltd., Winterthur (Switzerland).
For primary bibliographic entry see Field 8B.
W84-05238

SERVICE INSPECTIONS, OVERHAULS, REPAIRS AND REBUILDS OF HYDROMECHANICAL EQUIPMENT IN HYDROELECTRIC POWER PLANTS (REVISIONEN, REPARATUREN, MODERNISIERUNGEN UND UMBAUTEN VON HYDROMECHANISCHEN AUSRUSTUNGEN IN WASSERKRAFTANLAGEN),
Escher Wyss G.m.b.H., Ravensburg (Germany, F.R.).
F. Schneider.
Wasserwirtschaft, Vol. 73, No. 12, p 489-493, 1983. 7 Fig.

Descriptors: *Hydraulic machinery, *Hydraulic equipment, *Hydraulic turbines, *Hydraulic pumps, Maintenance, Maintenance costs, Economic aspects, Economic efficiency.

Regular service inspections and overhauls of hydraulic turbines and pumps are essential in order to prevent any major damage. Outdated plants should be rebuilt by installing modern equipment. The objective being to improve the economics and reliability of operation, and to ease automation. This will keep the hydrodynamic machinery in a good operation state, maintain its availability. and allow the generation of power from the renewable hydraulic energy source without affecting the environment. (Murphy-IVI)
W84-05265

8D. Soil Mechanics

DYNAMIC RESPONSE AND LIQUIFACTION OF EARTH DAMS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
T. A. Mansouri, J. D. Nelson, and E. G. Thompson.
Journal of Geotechnical Engineering, Vol. 109, No. 1, p 89-100, January, 1983. 16 Fig, 1 Tab, 17 Ref.

Descriptors: *Model studies, *Earth dams, *Liquefaction, Wave propagation, Elastic properties, San Fernando Dam, Finite element method, Equations, Interstitial water, Computer models.

A model for predicting the dynamic response and liquefaction of earth structures was developed. The model was based on Biot's theory for the propagation of elastic waves in a porous medium (Biot, M. A., Mechanics of Deformation and Acoustic Propagation in Porous Media, Journal of Applied Physics, Vol. 33, No. 4, p 1482-1498, 1962) and an empirical relation put forth by Finn for the volumetric strain resulting from an applied shear strain (Finn, W. D. L., Seismic Response and Liquefaction of Sands, Journal of the Geotechnical Engineering Division, ASCE, Vol. 102, No. GT8, Aug., 1976, p 841-856). The finite element method was used to solve the equations. The model was applied to a hypothetical earth dam. The model considered the soil as a porous material, saturated with water. Having separate constitutive properties, the soil skeleton and the pore fluid were treated as independent materials. Darcy's law was used to describe the motion of water in the soil skeleton. The results of the analysis were compared to the observed liquefaction in the San Fernando dam and were shown to be reasonable. Finn's equation was used to compute the volumetric strain due to shear strain applied by earthquake loading. By coupling Biot's theory for the propagation of elastic waves in a fluid saturated porous solid with the dilatancy equation it was possible to evaluate the increase in pore-water pressure and thus to predict liquefaction. The model can also be used to compute displacement, velocity, acceleration, effective stress and pore-water pressure. (Baker-IVI)
W84-04810

ANALYSES OF FLOW FAILURES OF MINE TAILINGS DAMS,
Texas A and M Univ., College Station.
J. K. Jeyapalan, J. M. Duncan, and H. B. Seed.
Journal of Geotechnical Engineering, Vol. 109, No. 2, p 150-171, February, 1983. 14 Fig, 3 Tab, 19 Ref.

Descriptors: *Flow, *Mine tailings dam, Dam failure, Dam design, Flow profiles, Flow characteristics, Mathematical models, Computers, Computer programs, Bingham plastic rheological model, Turbulent flow.

A characteristic common to most tailings dam failures is that the mine tailings tend to liquefy and flow over substantial distances, with potential for extensive damage to property and life. In order to be able to assess the potential for damage in case of such failure, it is necessary to be able to predict the characteristics of the flow and the possible extent of flood movement. This paper presents analytical

procedures for making such evaluations. The behavior of tailings materials during flow is represented by a Bingham plastic rheological model in these analyses procedures. It is apparent from the analyses that the flow of phosphate tailings would be expected to be turbulent but flows for other types of tailings would be expected to be laminar. The procedures described are applicable for flow of tailings on horizontal and sloping planes and in prismatic valleys. The analyses can be performed using dimensionless charts in the case of flow on planes, and a computer program in the case of flow in prismatic valleys. (Author's abstract)
W84-04812

INVESTIGATION OF FLOW FAILURES OF TAILINGS DAMS,
Texas A and M Univ., College Station.
J. K. Jeyapalan, J. M. Duncan, and H. B. Seed.
Journal of Geotechnical Engineering, Vol. 109. No. 2, p 172-189, February, 1983. 20 Fig, 4 Tab, 9 Ref.

Descriptors: *Flow, *Main tailing dams, *Dam failure, Dam design, Earth dams, Bingham plastic rheological model, Computer programs, Performance evaluation, Buffalo Creek.

A characteristic common to most mine tailings dam failures is that the tailings tend to liquefy and flow over substantial distances, with potential for extensive damage to property and life. The existence of these potentially hazardous earth structures is of great concern to the public and to the mining industries. In order to be able to assess the potential for damage in case of such a failure, it is necessary to be able to predict the characteristics of the flow and the possible extent of flood movement. A companion paper to this illustrated the various analytical procedures that have been developed for this purpose. The present paper describes a series of flume experiments that were conducted to check the validity of these analysis procedures. In light of the good agreement observed, the results of the analyses are then compared with flow movements observed in several case studies where failures have occurred. (Author's abstract)
W84-04813

FAILURE OF AN EARTH DAM: A CASE STUDY,
Garyounis Univ., Benghazi (Libya).
I. H. Khan.
Journal of Geotechnical Engineering, Vol. 109, No. 2, p 244-259, February, 1983. 12 Fig, 10 Tab, 19 Ref.

Descriptors: *Earth dams, *Dam failure, *Wadi Qattarah dam, Hydrogeology, Soil engineering, Climatology, Soil moisture, Design criteria, Libya.

In the semi-arid zones, seasonal variations in temperature and moisture content are extensive. This may induce severe cracking of the core of an earth dam, particularly in places where the soil is poorly compacted. The winter rains often result in flash floods leading to a rapid build up of reservoir level. Consequently, water flowing through the core has high gradients. Moderately dispersive soils, in such an environment, may become highly dispersive. Such a mechanism of failure has been postulated on the basis of a case study of an earth dam failure in Wadi Qattarah, Libya. Practical implications of this failure mechanism are pointed out in relation to earth dam construction practices in semi-arid zones. (Author's abstract)
W84-04814

ESTIMATING FAILURE PROBABILITIES FOR CALIFORNIA LEVEES,
California Univ., Berkeley.
J. M. Duncan, and W. N. Houston.
Journal of Geotechnical Engineering, Vol. 109, No. 2, p 260-268, February, 1983. 4 Fig, 2 Tab, 2 Ref.

Descriptors: *Levees, *Levee failure, *California, Gumbel distribution, Normal distribution, Probability distribution, Probabilistic process, Peat, Peat soils, Water level.

The probability of failure of California Delta levees was estimated using simple statistical procedures, based heavily on empirical data. Forty-four islands were included in the study, and it was found that the probability of failure was strongly linked to the thickness of peat beneath the levees. When the islands were grouped according to peat thickness, it was found that sufficient historical levee failure data was available to estimate the average probability of failure for all the islands in a given peat thickness group. The relative probabilities of failure for the islands within a group were then estimated using slope stability analysis and simple statistical methods. For each island a Factor of Safety Index (FSI) was computed for ranges in water level outside the levee and a range of values of the strength parameter, phi'. The water level was statistically characterized by the Gumbel Distribution and phi' by a Normal Distribution. The probability that the FSI would fall below some critical value was used to rank the probabilities of failure for islands within a peat thickness group. (Author's abstract)
W84-04815

BREACHING CHARACTERISTICS OF DAM FAILURES,
Leedshill-Herkenhoff, Inc., San Franciso, CA.
For primary bibliographic entry see Field 8A.
W84-05145

PRIMS DAM NEAR NONNWEILER - AN IMPORTANT PROJECT IN THE SAAR REGION (PRIMSTALSPERRE NONNWEILER - EIN NEUER ABSCHNITT IN DER WASSERWIRTSCHAFT DES SAARLANDES),
Landesamt fuer Umweltschutz - Naturschutz und Wasserwirtschaft, Saarbrucken (Germany, F.R.).
H. R. Lorson, H. P. Keitel, and E. Hermann.
Wasserwirtschaft, Vol. 73, No. 4, p 103-108, April, 1983. 7 Fig, 3 Ref.

Descriptors: *Prims Dam, *Nonnweiler, *Saar region, *Earth dam, Performance evaluation, Design criteria, Construction costs, Construction materials, Water resources development.

The Prims dam near Nonnweiler was completed in early 1982. The results of test filling have proven the satisfactory realization of the 62 m high rockfill dam with asphalt sealing. Therefore, operation of the plant, the most important one in the Saar region for water resources, started according to schedule. (Author's abstract)
W84-05236

8E. Rock Mechanics and Geology

MONITORING STRAIN DISTRIBUTION IN THE FOUNDATION ROCK OF LARGE DAMS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
K. Kovari, and G. Peter.
International Power and Dam Construction, Vol. 36, No. 5, p 35-38, May, 1984. 6 Fig, 2 Ref.

Descriptors: *Gravity dams, *Strain measurement, *Dam foundations, Dam safety, Load distribution, Albigna Dam, Switzerland.

The complete distribution of strain along boreholes in the rock foundation of large dams provides the best means of understanding the response of the rock mass to changes in load brought about by the fluctuations of the water level in the reservoir. In the case of the Albigna gravity dam, some of the healed joints opened up in the course of time leading to increasing deformation of the dam and to leakage of water. Using sliding micrometer measurements it was possible to recognize clearly these active discontinuities intersecting the boreholes. They made their presence felt by marked peak points in the strain distribution curves. The occurrence of only a few active joints and the high rigidity of the rock mass confirmed the excellent overall rock conditions at the Albigna dam site. Remedial measure to stop the underseepage of the dam were carried out in the summer of 1980. They resulted in a sharp decrease of water loss. (Baker-IVI)
W84-05101

8F. Concrete

STABILITY OF SLURRIES FOR THIN CUTOFFS IN PERCOLATED GRANULAR SOILS (ZUR STABILITAT VON SCHMALWANDSUSPENSIONEN IM DURCHSTROMTEN KORNIGEN UNTERGRUND),
Karlsruhe Univ. (Germany, F.R.).
K. J. Witt, and J. Brauns.
Wasserwirtschaft, Vol. 73, No. 12, p 521-526, 1983. 10 Fig, 7 Ref.

Descriptors: *Cements, *Cement slurries, *Slurries, *Soil properties, Barrages, Concrete mixes, Concrete construction, Concrete technology, Model testing.

Thin cutoffs made of cement-bentonite-slurries are often used for vertical seals, for instance in and underneath the lateral dikes of rivers when barrages are to be constructed in riverbeds. A successful application of such cutoffs may be questionable under the conditions of very coarse grained sediments which sometimes occur in the upper regions of big rivers. The risk of instability and erosion of the fresh slurry-type mix comes up here. The paper describes investigations on the behavior of cutoff mixes regarding their stability and setting behavior. The effect of jellying admixtures is investigated particularly. The problem of stability of fresh mixes in coarse grained soils is demonstrated through model tests. (Author's abstract)
W84-05269

8I. Fisheries Engineering

RESERVE FLOW AND OTHER PRECAUTIONS TO PRESERVE FISH LIFE AT PRESENT IMPOSED FOR MICRO-HYDROELECTRIC POWER STATIONS IN THE AUVERGNE-LIMOUSIN REGION OF FRANCE (DEBIT RESERVE ET AUTRES PRECAUTIONS PISCICOLES ACTUELLEMENT IMPOSEES LORS DE L'INSTALLATION DE MICRO-CENTRALES HYDROELECTRIQUES EN AUVERGNE-LIMOUSIN),
R. Cuinat, and J. J. Demars.
La Houille Blanche, Vol. 1, p 49-58, 1982. 2 Tab.

Descriptors: *Fish guiding, *Micro-hydroelectric power stations, *France, Fish barriers, Fish handling facilities, Fish management, Fish passages, Optimum development plan.

In France, authorization is required from the Prefect's office (department administration level) before a hydroelectric power station of less than 500 kW (since 1980 is 4,500 kW) gross power (micro-power station) can be built. The legislation on this was made many years ago (Law of 1919) and is relatively liberal. Since 1974, as a result of an increasing number of projects carried out in the seven departments of Auvergne and Limousin, and awareness of environmental protection problems, authorization have been generally accompanied by more stringent requirements to be complied with by the construction. Until more accurate technical and scientific data becomes available on the extent to which these dams affect fish breeding, a 'basic legal minimum flow' (BLMF) is prescribed which may range from 70 to 130% of the characteristic rate of flow of the river. This coefficient is proposed by the regional board of the Fishery Office in accordance with quality of aquatic life, accessibility for angling and length of river diverted (generally several hundred meters for every 4 km). The basic minimum flow selected is regulated by a lower value (minimum 0.7 BLMF) during the cold season, a higher value (maximum 1.3 BLMF) during the warm season (April to September), when invertebrate production and trout-growth are at a high level, and electricity requirements are usually lower. Construction of a fishladder and a simple flow control device is almost always required. The authorities usually seek advice from

anglers' associations and the regional board of the Fishery Office (technical department). (Murphy-IVI)
W84-04951

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